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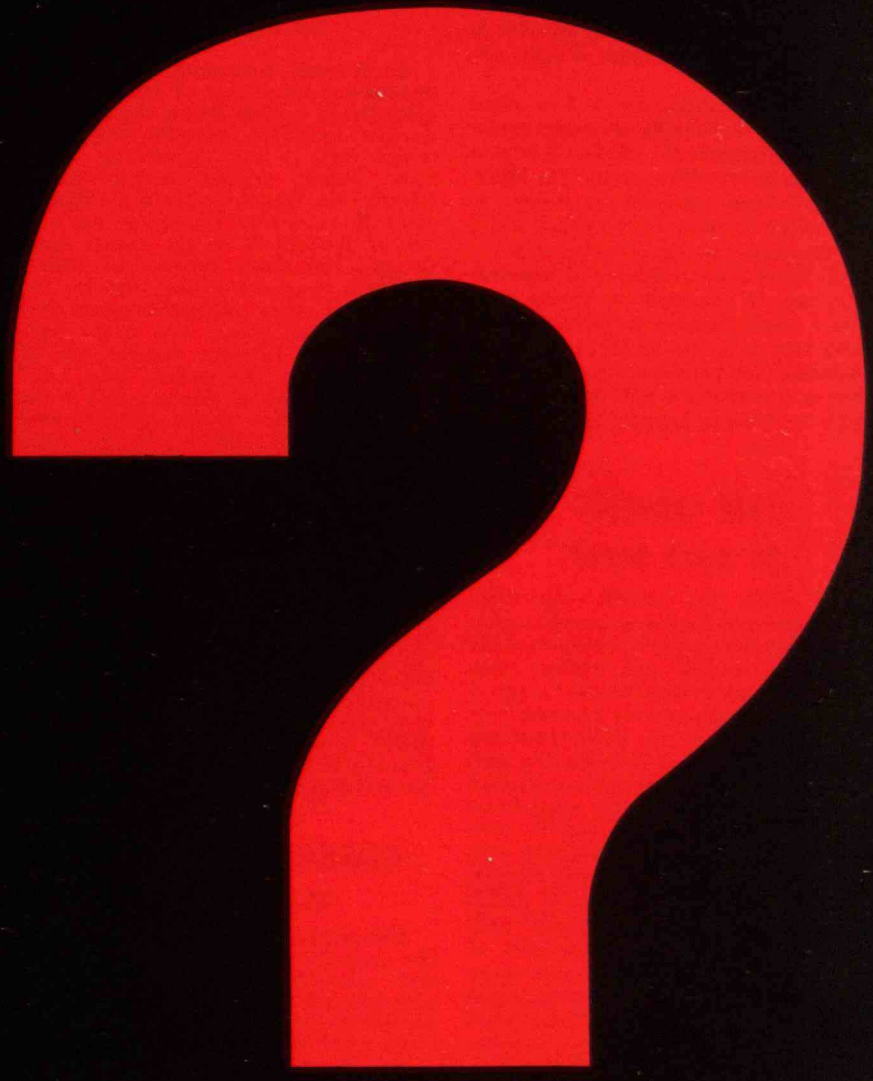
Bruce S. Schwartz on the Clean Air Car Race

Chandler H. Stevens and Thomas B. Sheridan on the Politics and Technology of Citizen Feedback

Benson R. Snyder on the Hidden Curriculum in Higher Education

Technology Review

Jay W. Forrester:
Alternatives
to Catastrophe–
Understanding
the
Counterintuitive
Behavior of
Social Systems



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The First Line

In its report just released, the year-old Commission on M.I.T. Education complains that today's college students are too often disillusioned: "Anxious to learn how to do good, they are taught how to do well." Students now seek "the opportunity to fulfill themselves on their own terms, and they ask that the schools provide them with the freedom to make critical decisions about what they are to study," says the Commission.

The Commission thus raises for M.I.T. the question which students have brought to every American university: What is to be the role of the students themselves in determining what their education is to be—and how it is to accomplish their goals? Can there be a "democratic" process which describes curricula, determines course content, sets standards, and qualifies teachers and students—through which, in effect, are maintained the standards of the institution?

Shall students in their zeal to help improve the conditions in a tenement redesign that building—and in the process believe they have learned what they will need to know about materials, color, space, and structures for a 30-year career in architectural practice? Can students, determined to keep a city's air clean, sense the need for understanding the fundamental fluid dynamics which controls how plumes from chimneys enter and eventually dissipate in the atmosphere?

There must, of course, be communication and advice. Clearly, faculty and students need to share an understanding of their value systems, their goals, and their views of how to achieve them. But ultimately the strength of a university is the strength of its faculty, and the strength of a faculty is its wisdom. No freshman should come to M.I.T. expecting to vote with Arthur Ippen, Paul Samuelson, Victor Weisskopf, or Warren Lewis on what, how, or when he should study; he must come to M.I.T. because he wants to study what such men believe will be important to him.

It is not unreasonable to assume that doing well is in fact the route of choice toward doing good.—J.M.

In This Issue

Jay W. Forrester's essay on "Counter-intuitive Behavior of Social Systems" represents a summation of a decade's work in the field which Professor Forrester originated as "industrial dynamics." Long-time *Review* readers will be familiar with his earlier contributions through excerpts from his book of that title published in January, 1964, and through his paper on "A Deeper Knowledge of Social Systems" in April, 1969. We publish the current article with special pride, believing that it represents a comprehensive summary of a uniquely important—if controversial—method through which the social and engineering sciences may together bring us a better understanding of the most complex issues of our age.—J.M.

Next Month

Donald A. Schon, President of the Organization for Social and Technical Innovation, Inc., on "Implementing Programs of Social and Technological Change:" We have expended much intellectual energy on technological innovation applied to social problems without ever facing up to the central trouble—our inability to carry out any programs of constructive change at all. "If an idea is in good currency, it is probably no longer appropriate to the situation."

Lester C. Thurow, Professor of Economics, M.I.T., on "Research, Technical Progress and Economic Growth:" Economic growth is often thought to depend in some way on a country's investment in research. A determined analytical search for the connection, however, yields less real evidence than we might expect.

C. O. Miller, Director of the Bureau of Aviation Safety, National Transportation Safety Board, on "Why 'System Safety'?": a new science is now entering civilian life, representing increasingly conscious, organized response to increasingly hair-raising dangers as man-made systems grow more complex and venture further from the safety of the natural world.

Contents
for
January, 1971

Technology Review

Articles

Departments

Trend of Affairs

Cambridge Journal

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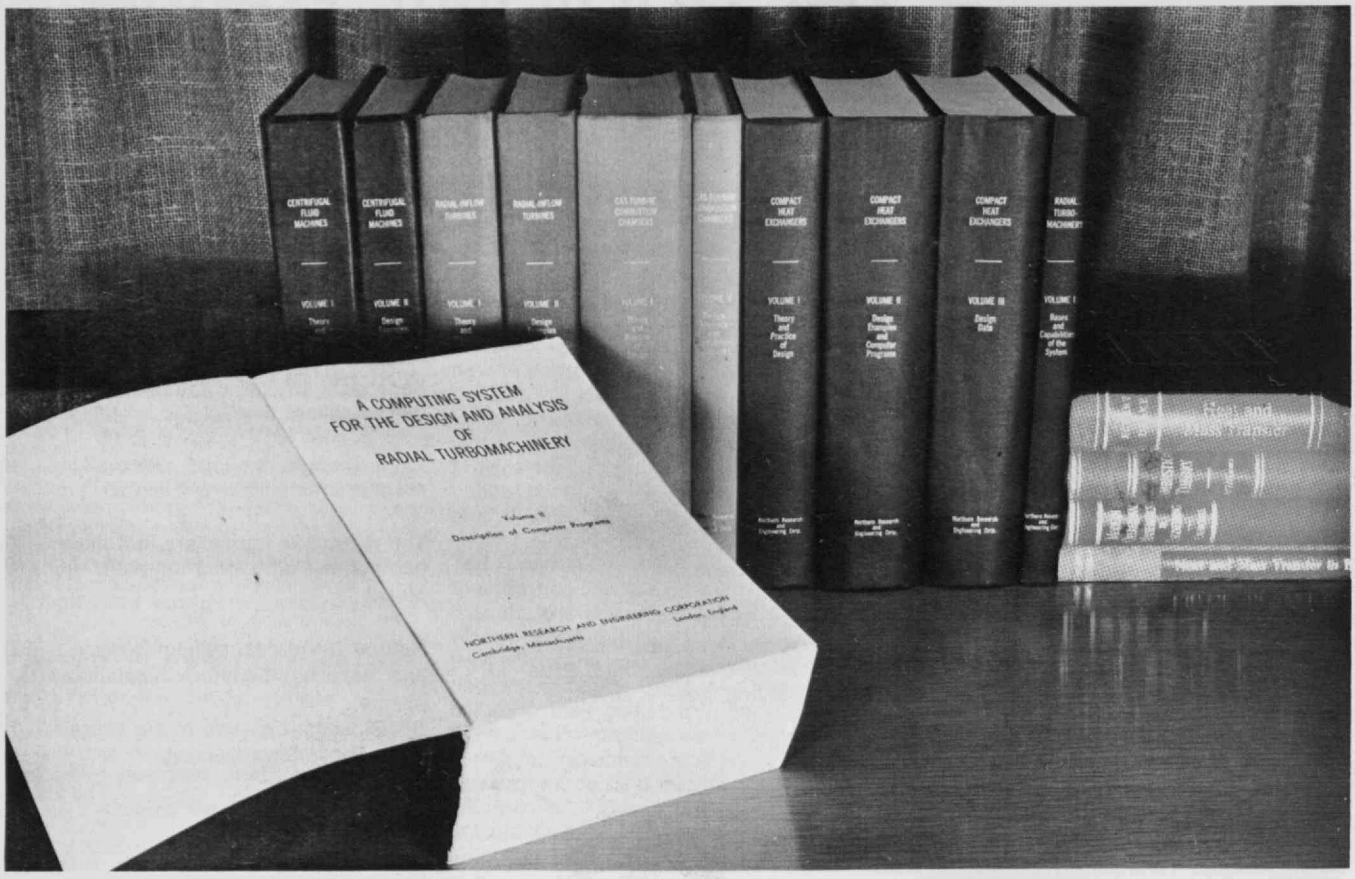

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*These data were reported in the Congressional Record of September 11, 1970.

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289

Science Review
Robert C. Cowen

The dramatic success of a Russian nuclear-fusion research system has set off a wave of optimism regarding the chances of controlling this energy source. But from the laboratory to the power station will be so troublesome a step that it might not be attempted

Fusion Power: Ten Years to the Great Decision?

British physicist R. S. Pease thinks his Russian friend Lev Artsimovich may be in league with the devil. The Russian's progress on the boggy road to controlled hydrogen fusion has been so speedy it almost seems as though he had supernatural help.

I think Dr. Pease has got it wrong. The success that has sent a wave of encouragement among plasma physicists in every country may have more to do with the fact the Russians are good capitalists when it comes to spurring on a research team. Artsimovich's Kurchatov Atomic Energy Institute pays bonuses for work well done. One of Dr. Pease's men discovered this to his benefit when he was transferred there for a year. So maybe Artsimovich's devil was just the good old profit motive.

Joking aside though, the famous Russian has demonstrated an intuitive insight into the mysteries of plasma that amounts to genius. Thinking from only a hazy theoretical base, he saw opportunity where others saw discouragement. His work has now sparked a flurry of experiments around the world. At the Culham Laboratory for controlled thermonuclear research, which Dr. Pease heads, the physicists now can see a glimmer of light ahead along what had seemed a very black tunnel. And they think they have a bit of light of their own to add to it too.

All of this has given new vigor to thermonuclear work in Britain, and I gather elsewhere too, which it badly needed. Such research is unique in being a very long-term partnership between scientists and society. Its fruition depends on the staying power of that partnership probably more than on any other one thing. Like any long-term successful marriage, the partnership needs occasional renewal of its hope and vision. For this, Dr. Pease is grateful to his Russian colleague.

There's no point in going into great detail here about the Russian accomplishment. That has been widely reported over the past couple of years (see *Technology Review* for July/August, 1969, p. 83). Having digested its results, Dr. Pease now is willing to make some predictions as to the progress that the public which pays for this seemingly interminable research can reasonably expect. Experts in other countries may or may not agree with him in detail. But his views at least give laymen like me a roughly valid perspective.

The researchers' first goal is to get the kind of nuclear reactions that power stars and H-bombs running under control in the laboratory. Then they will try to build a prototype electricity-producing reactor. Eventually and hopefully, this will lead to commercially economical thermonuclear electric power. As a rule of thumb, to reach that first goal, the physicists are shooting for temperatures of 100 million degrees Kelvin in a gas of protons and electrons, called a plasma. That plasma should have a density of at least 10^{14} protons per cu. cm. And the physicists must be able to confine it tightly (with magnetic fields) for at least one second. Meet these conditions, and you should be able to get thermonuclear fusion running under control.

The plasma has many subtle ways of escaping magnetic confinement, whereupon it hits the container walls and cools below fusion temperatures. A few years ago, the confinement situation seemed rather discouraging. Theory, as then understood, suggested there might be a fundamental limitation, at least in some of the major research lines being followed.

Artsimovich refused to be intimidated. Partly through physical reasoning, partly through what seems to have been sheer faith, he pressed on with a series of experiments with doughnut-shaped machines. Like many other doughnut devices, these use an encircling magnetic field to compress the plasma into a thin ring, to heat it and confine it there. In addition, Artsimovich induced a current to flow through the plasma, further heating it and adding its own magnetic field to the confining forces. He called such machines Tokamaks, for "tok" meaning current. With them, he has confined plasmas for periods of 1/50 to 1/20 of a second. He has reached temperatures of 10 to 20 million degrees Kelvin with plasma densities up to 5×10^{13} particles per cu. cm. That's within a factor of ten of the long-sought laboratory goal.

Laboratory Optimism

Western physicists, at first skeptical of Artsimovich's claims, now accept them. A precision measurement team from Culham visited the Moscow laboratory and confirmed the results. Now advanced Tokamaks are being built in many countries. And a swiftly engineered version at the Princeton (N.J.) Plasma Physics Laboratory reconfirmed the Russian work last summer.

Dr. Pease takes encouragement from this because of the suggestions he sees for further progress. You have to take these in the context of some very real uncertainties of the Tokamak system.

First, those high temperatures refer to electrons only. The protons, which are the energy-producing fusion particles, lag in heating. They should warm up as confinement time and density increase. So far, their temperature has followed electron temperature as theory predicts. That suggests the theory is well founded, the system and its projected performance understood. But no one will know for sure until advanced Tokamaks have been running for a while.

Second, there are unexplained energy loss mechanisms in the system. They don't look to be troublesome. Yet, again, no one knows whether or not they will grow into a menace as Tokamaks are scaled up into the fusion reactor range.

In spite of such uncertainties, though, the Culham team sees much potential for development in the Tokamak scheme.

For one thing, it has what appears to be an efficient type of magnetic confinement. This could be very important because magnetic fields are quite expensive. Efficient magnetism could make a fusion reactor considerably cheaper. This is, Dr. Pease says, undoubtedly the most advanced confinement yet. Taken together with what it has accomplished so far, it could lead directly to a laboratory reactor. Just doubling the size of a Tokamak, he notes, they would expect to boost confinement time by a factor of four and could drive proton temperatures up to the ignition point. Again, he says this with due reservation for the uncertainties cited.

Add to this the potential of one of Culham's own versions of the doughnut machines, and you have the basis for Dr. Pease's present cautious optimism. The Culham machines are derived from a device called Zeta. In this an external magnetic field pinched down and heated the plasma. Zeta gained fame years ago when overly excited publicists claimed erroneously that it had produced fusion. It hadn't, and Culham men still wince with embarrassment at the memory. But, like Tokamak, Zeta unexpectedly showed what may be a way to licking the confinement problem. Its pinched-down ring of plasma is unstable initially. Then, automatically, it slips into a stable configuration. While this too eventually breaks down, Culham experimenters think they can refine the system to correct it. They now are testing an advanced version with which they hope to prove their point.

If the encouragement that all this has inspired holds up, Dr. Pease expects controlled fusion to be running in laboratories by the next decade. But he says he still doesn't know when fusion power will be available commercially. "We don't know it," he explained, "for a very good reason. We don't know what magnitude of investment society is willing to put into it.

"We work with two levels of uncertainty —the technical and the social. Success in our work means economic success. And we won't prove that until the very last stage. Right now, world investment in the work runs to about $120 million, about a third of what Americans spend on continued development of fission-based power. Will society, in the long term, be willing to back our intermediate success when we do get fusion running in the laboratory? Even then the much greater investment needed to develop a prototype reactor will still be an uncertain gamble. It could pay off handsomely. It could fail dismally if fusion reactors proved to be just not economical."

Hair-Raising Practicalities

Indeed, the reactor problem already looms as a gray, if not black, cloud on the plasma physicists' horizon. Robert Carruthers, head of Culham's Applied Physics and Technology Division, says some of the prospective problems seem hair-raising. Culham hosted the world's first conference on possible fusion reactor design last year. Dr. Carruthers, who helped organize it, says it was more than high time that the experimenters began to think of reactors. They could easily find themselves pursuing laboratory systems that simply could not be economically scaled up to power-plant size.

The plasma container is a real puzzler. While magnetic forces will control the 100-million-degree particles, the container of a full-size reactor will take terrific neutron bombardment. In many schemes, it would also be surrounded by a blanket of material to absorb and transfer the power-producing heat. So the container would have to stand up to fairly high sustained temperature as well.

No one knows what material they could use for container walls, Dr. Carruthers says. He adds that "the more you looked at the problem, the more your hair went up."

Then too, machines like Tokamak use a pulsed form of containment. In a full-size reactor, magnetic forces would pinch down the plasma. Fusion would occur. Then the plasma could expand a little while energy was taken out to make power, only to be pinched down again, and so on. Right now, the experimental machines use banks of capacitors to store up the energy used to generate magnetic pulses. Take a hard look at such systems, Dr. Carruthers says, and you see immediately you can't use capacitor banks for full-sized power plants. They're just too expensive. So you can't scale up present research devices that rely on capacitor banks. "People," he says, "are scratching their heads about this."

Economics of magnetic fields are another uncertainty. Culham experts think these could be the biggest single cost factor in a fusion reactor. Yet Dr. Carruthers says the scale-up calculations many experimenters make on their devices are "pretty slap-happy." Do the mathematics correctly and you find ridiculously high magnetic fields would be needed— fields no cost accounting would tolerate, no known material could support.

Such uncertainties at this stage of fusion research by no means imply a discouraging outlook for practical power plants. They do point up Dr. Pease's warning that, even when laboratory control problems are solved, the question of whether or not to go for broke with reactor development may still be a gambler's choice.

"The next decade," he says, "should see experiments producing abundant thermonuclear reactions in the laboratory, if the present rate of progress is maintained. I would hope the energy released in these experiments would be comparable to the energy in the plasma. I think that's the plausible story we can see and promise the public in the next decade." That is the light he sees ahead along the tunnel. He adds, though, "At that point, society has to ask what it's going to do about it. The next decade could make or break the subject."

Robert C. Cowen, Science Editor of the Christian Science Monitor, *writes regularly for* Technology Review *from London, where he has been stationed for 18 months.*

Education Report
B. Alden Thresher

"The time may come when a college will not be given access to a student's test scores unless it makes a full disclosure . . . about itself. . . . There is a very real parallel between these devices and . . . consumer-protection measures . . . in supermarkets"

Testing Colleges as Well as Students

The report of the three-year study of the Commission on Tests of the College Entrance Examination Board proposes changes that may well have a revolutionary effect on college admission practice. The Commission's assignment to scrutinize tests *and their uses* was a mandate to look broadly at the entire process of transition from secondary to higher education. Its most important conclusion was that the Board and its constituent colleges should do as much to aid the student in selecting a college as it now does to aid the college in selecting students.

No such broad appraisal of the problems of college admission has been attempted since the founding of the College Board in 1900. In fact, during most of the intervening period the social issues about access to higher education that now loom so large were scarcely perceived at all. The Board, started by a small group of eastern institutions, now has a nationwide membership of 896 colleges, while secondary schools, school systems, and associations bring the total voting membership to over 1,500. Though the Board has broadened its concerns far beyond tests—to include, for example, educational guidance and the evaluation of family need for student financial aid—it is still best known for its tests, taken by some 2 million students each year.

After using essay-type, individually read examinations for 40 years, the Board in 1942 adopted standardized objective testing as its main instrument of educational assessment. Not only would it be impracticable to deal with the present volume of testing without machine scoring; experience has demonstrated that despite extraordinary efforts to achieve fairness, the judgmental grading of essay tests even by experienced teachers remains erratic and unreliable. The impersonal nature of objective tests frees them from the kind of bias that is introduced when teachers' marks are influenced by whether they like the student.

Despite the obvious practical utility of objective tests, the past 25 years have brought increasing expressions of dissatisfaction, both with the tests themselves and with the ways in which they have come to be used. Some scholars condemn as anti-intellectual the practice of forcing a student to select a single "right" answer to a complicated, many-sided question. Counselors, while granting that test scores establish a *probability* about performance in conventional courses, are even more impressed by the many instances in which the prediction turns out to be wrong. Public school officials dislike "external" tests, controlled by outside agencies. Students know that the quick, "test-wise" youngster has an advantage over the unpracticed and unadvised. The art and lore of test taking are highly cultivated by some. Students from ethnic minorities, already educationally disadvantaged, are often further handicapped by tests normed on middle-class groups from a different kind of environment. We have come to realize that while "Scholastic Aptitude" Tests measure proficiency in verbal and mathematical skills essential in conventional college courses—and indeed in most professional work—they leave undiscovered many abilities and talents of great significance in the ultimate social effectiveness of the student as worker, as citizen, and as an individual personality who may make a unique contribution to the life of his times.

The usefulness of tests depends on the purely empirical finding that they do establish certain probabilities about success in courses sufficiently stable and conventional to permit accumulation of statistical evidence. Yet they do little to prescribe for the student what he should do next. They were, after all, established in an institutional setting aimed primarily at judging the student, not at helping him. The results remain empirical because we still know so little about how learning takes place, about the nature of cognition, about how knowledge is organized in the mind, about its relation to action, or about the effect of emotional states on learning. Elting Morison has pointed out that it is less important to decide what a student ought to learn than to discover how the mind, operating as it does in an emotional field, works.

Perhaps most important of all, it is now apparent that access to higher education is a matter of deep societal significance, transcending the traditional scholastic limitations that have hedged it round. With something like three-fourths of all high school graduates going on to some kind of further education, widespread insistence on getting only the "best" students raises many embarrassing questions about who is best and how we can tell. College teachers often perceive as best those students already farthest along toward becoming copies of and successors to the teachers themselves. These are easier and more fun to teach, being already imbued with the teacher's system of values and accustomed to his discipline-oriented frame of reference. More often than not these students turn out to be white, male, and middle class. The current wave of "open admissions," though full of risks, recognizes the overmastering need for measures that differ from the grudging admissions practices of the past.

So the Commission's most significant conclusion goes beyond tests to the broad context of the transition from high school to some form of post-high-school education. The word college is too narrow, because a wide variety of educational programs is needed, some with little resemblance to the conventional nineteenth-century stereotype of a four-year liberal arts course. For the majority of students the first stage beyond high school will be a community college embodying stepping stones to the university as well as the broad range of modernized, vocationally oriented courses for which this generation of students shows such eager demand.

An annual crop of nearly two million students will be distributing itself among 2,600 colleges, universities, community colleges, and specialized institutions. Many students will of necessity fall back on the nearest "open-door" college, but for a substantial proportion some choice will be possible. So we have a system of reciprocal selection in which students seek to select colleges and colleges seek to select students. This, in economic terms, is a market, and the first essential for an effective market is that full information be available to both buyers and sellers about the various options

open to them. Only then can they shop around intelligently.

Colleges have been known to seek exhaustive information about their applicants with little idea how to use it when they got it. Students, for their part, have been given little really helpful information about the college; what little they had beyond hearsay, rumor, and folklore has been couched in the "selling" phraseology of catalogues and brochures. While asking the student for objective data about himself, colleges have been reluctant to give similarly objective data about themselves. This has come about because the information system, of which tests form one part, has been run by and for the colleges. The selection process has been "collegiocentric." The easy assumption was made that the student could take care of himself; if refused, he could find another college that would meet his needs. But the student too often does not know what information he needs, how to find the information he wants, or what to do with the information he has. The colleges have too easily fallen into the self-serving belief that everything they do is for the student's best interests, and that what is good for College X is also good for the country.

Enough research has been done in recent years to demonstrate that the social and intellectual "climate" of a college can be helpfully described in objective terms through systematic canvassing of the attitudes and practices of students and faculty. Such characteristics as relative selectivity, "standards" as expressed by test scores and school marks, drop-out rates, and faculty-student contacts and attitudes can be statistically compared. The time may come when a college will not be given access to a student's test scores unless it makes a full disclosure of such data about itself.

The Commission urges that the Board regard its clientele as made up not only of colleges seeking information about students but equally of all students seeking information about colleges. The student's problem is complicated by the fact that he is still in the process of discovering himself. His goals may properly be subject to change while he explores the options which the worlds of education and work hold out to him. The ultimate solution may well be a computerized system capable of carrying on a running dialogue with the student, responsive to his queries, willing to listen to his preferences, and ready to explain whatever branching paths seem likely to meet his need. The whole would be subject to correction as his interests evolve. This proposal is only one of a number of long-range suggestions that will obviously require time to work out, aided by research, experiment, and pilot programs.

The Board's member colleges have had the opportunity for several years of publishing some statistical information about their selectivity and standards in the College Boards' "Handbook," but many have avoided full disclosure. Should the Commission's recommendations be adopted by the Board's trustees and membership, colleges—as well as students—will, in effect, have to take tests by submitting to a type of searching scrutiny to which they have not been accustomed. It is possible to set up typologies of colleges based on measurable characteristics and typologies of students that help the applicant to discover what sort of a peer group he would be joining. There is a very real parallel between these devices and such consumer protection measures as true-weight labels in supermarkets. Indeed, the entire process of transition to college is seen as in need of consumer protection measures. The social crisis in the delivering of education, in all its complexity, rivals in gravity the crisis in the delivery of medical care. The conditions of access to higher education represent a kind of tap root that connects educational institutions to the larger society that generates and sustains them. We need to look to the health of this root system.

Space limitations prevent a full summary of the Commission's report here. It proposes experiments with college locating services, local guidance centers to aid dropouts and other students not well served by existing school guidance staffs. It calls for job entry tests to help the student who is not college-oriented and whose training needs to be vocational. It suggests self-scored and self-administered tests designed along present lines but taken by the student when and as he pleases, to enable him to "take his own temperature" and answer the question: "How am I doing?" It proposes experiments with plans to give the student upon taking a test a discussion of whether the "right" answer is in fact the only acceptable one, and so to help educate as well as judge him. It even contemplates the possibility of a dual structure for the Board, one-half devoted to serving the information needs of students by "testing" colleges; this would be controlled by students. The other half, controlled as now by colleges, would be devoted to testing students. The whole might even be called the Career Entry Examination Board. Some recommendations, such as a reduction in the "speededness" of tests, can be put into effect promptly. Others will require years of research.

Readers interested in fuller particulars of the Commission report may order the summary volume, "Righting the Balance," at $2 per copy and the "Briefs" by individual members at $3 per copy, or both together at $4.50, from the College Entrance Examination Board, Publications Mailing Office, Box 592, Princeton, N.J. 08540.

B. Alden Thresher, who was Vice-Chairman of the C.E.E.B.'s Commission on Tests, was Director of Admissions at M.I.T. from 1936 to 1961. He studied business administration at the Institute in the Class of 1920, was a member of the Department of Economics from 1929 to 1947, and has now retired to Cocoa Beach, Fla.

The research-funding retreat goes on. It has now reached the point where national science-politicians admit that the U.S. must be second to other nations in some fields. In that case, the question becomes: Which?

Not Like the Olympics

American science is going downhill. America's technological superiority—its very basis of world influence and power—is gravely threatened.

These two conclusions, by many authorities, have been stated in Washington with increasing anguish for months. They have been repeated by many of the country's best scientific and technological minds.

Yet they have been received at almost every official desk in this far too pacific ocean of officialdom with great silence and complacency. The Administration line has remained: hold the line; save the economy; don't rock the budget; support the President; admit nothing.

This is not an Administration in which internal argument or dissent is much tolerated. The trouble with arguments is that they always leak out to be blown into headlines by nasty reporters. Mr. Nixon, like John Kennedy, squeaked into office. Unlike Kennedy, he has not increased his popularity; the November elections showed that. So, in this orderly, organization-chart administration, nasty headlines remain unwelcome. In 1971 and '72, as in 1969 and '70, there is likely to be far too little Administration discussion of some issues, including the very nasty one: Is the United States slipping toward scientific-technological inferiority?

We are still far from it. We are still near our peak of scientific-technological spending and achievement. And some nonscientists are understandably rather sick of the scientific fat-cats—professors who swallow grants like Grant swallowed Richmond, and fatuous owls who wear science as a halo to pronounce on everything from science to sex.

Squeezing Out the Junk?

The idea is in fact pretty popular that "in cutting science budgets, we'll really cut out the junk, and everybody knows there's an awful lot of junk." There sure is. The problem is to dissect it out without slicing through nerves. I remember saying once to a wise old physiology professor, who hated junk, "You know there's far too much drivel in all these growing mountains of data that people are turning out. Wouldn't it be better to move back a little to the day when there was a lot less research, with more of it good?" He said: "There was never such a day. In the Twenties we had far fewer scientists and far less money and far less literature, and an equal proportion of junk."

In other words, in science as in the rest of real life, if a thing is worth doing, it's worth doing badly—to an extent. Anyway, there is little sign so far that the current shrinkage of science is squeezing out just the bad and leaving the good.

The total shrinkage, one feels, is continuing. It is continuing despite some hopeful actions and some equivocal evidence that the damage *as of last spring was* not as bad in the universities as many persons feared.

A new National Science Foundation study of a sampling of 100 universities (with answers from 86) shows that despite shrinking federal funds, expenditures from all sources for scientific education and research rose some 15 per cent between July 1968 and June 1970. In other words, some new money was extracted from students, statehouses and other sources, including precious endowments or long-saved capital funds.

The total number of graduate students also remained surprisingly unchanged; the number of full-time graduate students declined only by 1 per cent, despite the fact that the number of students supported by federal funds dropped 8 per cent.

But—after these reassuring-sounding facts are stated—there are also these. Despite the total funds increase, net purchasing power dropped 5 to 10 per cent. Full-time graduate enrollments in mathematics and in electrical engineering dropped 8 per cent; physiology, 6 per cent; chemistry and biochemistry, 5 per cent.

Also, says Dr. Carl M. York of the President's Office of Science and Technology: "We can't be sure yet—the time delays in reporting are very great. But we think science enrollments were down this last fall. The impact of change is slow."

The Bright Side

The Office of Science and Technology, which is the office headed by the President's science adviser, also points with pride to the fact that President Nixon, while cutting almost every other field, increased funds for academic research in fiscal 1971 by 7 per cent—indeed phenomenal in Washington today. In other words (by late November 1970 estimate) academic research obligations could go from fiscal '70's $1.464 to $1.570 million. Or—the trouble in writing about this is that Congress at this writing is still not through appropriating for the year that began last July!—this might slip a little more. Even 7 per cent is not much more than the price of inflation.

Another caveat: this 7 per cent will be only *obligated,* not *spent* in the fiscal year between last July 1 and next June 30. Actual *spending* this academic year might go up just a few per cent.

The above, at any rate, are the optimistic reports. Now hear these.

The *fiscal 1972* fund for academic research—to be disclosed in the President's early 1971 budget message—may *drop once again* in real dollars. The advance guessing is that it may be some 6 per cent.

Total research and development obligations, by Mr. Nixon's projection, will be $15.8 billion this fiscal year compared with $16.4 billion in 1970. Defense research and development, space, A.E.C.—all are down now far more than environmental or transportation research and development, the newly relevant needs, have been pulled up.

The United States science and technology budget (total research and development) was only $74 million in 1940, $1 billion in 1950, $7.7 billion in 1960. But times have changed; we are more technological. The $14.8 billion of 1965 was 12.6 per cent of the federal budget; 1968's $17 billion, the peak in dollars, had dropped back to 9.5 per cent (the 1961 level), and 1970's was around 8.5 per cent.

One result is that in November 1970 (by estimate of Dr. Wallace Brode, former

Dr. Edward E. David, Jr., being sworn in as the President's new Science Adviser at a Rose Garden ceremony at the White House last September. His doctorate is from M.I.T., his expertise is in computers and communications, and his previous allegiance was to Bell Telephone Laboratories. (Photo: United Press International)

president of the American Chemical Society), there were 45,000 unemployed scientists and engineers, and probably far more underemployed, selling real estate or running Chicken Delight stands.

Rotting on the Vine

In Brode's words, this is "a waste of a national resource." In the words, during September, of one affected employer on Boston's famous Route 128, Dr. Dennis M. Robinson, president of High Voltage Engineering Corp.: "The tragedy for the whole country would be if this national research structure we have developed were left to die on the vine. We wouldn't see the effects immediately, but the fruits of the research harvest would begin to disappear in 5 to 20 years."

The fruits will begin rotting in much less time than that, in the opinion of the acerbic Dr. Philip H. Abelson, editor of *Science,* new president of the Carnegie Institution and no friend of junk science. He sees Japan and West Germany already pulling ahead in applying technology to new, saleable products. "This country is going to find it very difficult to maintain the standard of living to which it's becoming accustomed," he warns.

Dr. Raymond Ewell, research vice-president of the State University of New York at Buffalo and a student of the Soviet Union since 1928, points out that the Russians—though poor producers of consumer products—are doing so well in producing steel that "they will certainly exceed the U.S. in the next two to three years." It is this new kind of militarily-oriented technological muscle, he feels, that is now enabling the Soviet Union to challenge the United States in the oil-rich Middle East, in the Mediterranean Sea and—in current double-talk over submarine "facilities"—in Cuba (for more on Dr. Raymond Ewell's thinking, see p. 74).

As to research in the universities and similar laboratories—much of it basic, some applied, some hard to classify into neat "pure" or "practical" categories—Dr. Philip Handler, president of the National Academy of Sciences, feels there has been "a fall of perhaps 30 per cent since fiscal year 1968" in "the scale and scope of our national scientific endeavor" because of the combined effects of inflation and decreases or levelings in federal funds. He speaks in plain and sad terms of "the crumblings of the scientific enterprise" in this rich country.

Lowest Morale Since WW I

He told the House Science Subcommittee, in July, in some of the most ringing and statesmanlike words yet uttered in this science crisis: "Our national apparatus for the conduct of research and scholarship is not yet dismantled, but it is falling into shambles. Morale of the scientific community is lower than at any time since World War I.

"New fields of scientific exploration clamour for attention and for funding. Moreover, national interest in these seriously underfunded areas was aroused largely by federal initiatives, e.g., exploration of the oceans and their potential for societal purpose; ecological research which should underpin actions designed to preserve the natural environment; multidisciplinary studies required to provide the understanding necessary to rehabilitate the cities, to develop a truly modern transportation system, to improve the delivery of health care and to modernize our educational system.

"Meanwhile, the orderly development of the natural and social sciences has proceeded apace, offering exciting opportunities for important new starts on the scientific frontiers, starts that require funds for several new radio-telescopes, optical telescopes, planning of the next high-energy accelerator, ocean-going research vessels, instrumented satellites and the next generation of the instrumentation of 'small science' such as mass spectrometers, ultracentrifuges, nuclear magnetic resonance spectrometers, high voltage and scanning electron microscopes . . .

"These and others have been deferred for several years and the American lead in science is in jeopardy."

Then he pleaded: "Please understand that loss of that lead is not equivalent to defeat in the Olympics or the America's Cup races. It bodes ill for our future national security and for the vigor of our economy."

The National Science Board, which advises the National Science Foundation, put the matter this way: "U.S. science effort is currently threatened with possible mediocrity . . . It is clear there will be a day of reckoning for U.S. science and for the national well-being. That day may be very near."

Which Sciences Are Needed?

Meanwhile—back at Congress during all these warnings—Presidential Science Adviser Lee A. DuBridge appeared before the House Science Subcommittee and said that the United States must just "accept" the fact that it will be second to some other countries in some fields of science and technology.

Dr. DuBridge was then succeeded as presidential adviser in August by Dr. Edward E. David Jr. of Bell Telephone Laboratories. And he, too, in answer to reporters' nasty questions, conceded that the United States must accept being second in some areas. But at the same time, he added, "I would not want to see us fade in the fields essential to our well being."

Which fields are those? What must the United States do to avoid being second in them? What kind of fresh "science policy" does this country need to put 90,000 unemployed or misemployed technologists to work rather than losing them to Chicken Delights?

These are among the questions that are now occupying the thoughtful men, including Dr. David, among Washington's science leadership. Next month we hope to examine some of their thoughts.

Victor Cohn, who writes regularly for Technology Review, *heads the science writing staff at the* Washington Post.

National Report
Victor K. McElheny

"The fundamental aim of any U.S. energy policy should be to keep the range of choices as wide as possible, to keep the energy sources competing as vigorously as possible to hold the price down. The idea of holding down the price is not so much to fill up the American home with gadgets as to move the economy more swiftly to recycling just about everything that can be recycled"

Energy Shortage and Energy Choice

In a society supposedly dominated by technology, and not by the men who create technology, many believe in a rather gray folklore of technological inevitability. The idea seems to be that machines always escape their masters, breeding ever larger machines which then are always installed, in defiance of human needs. In such a system, people are "locked into" a technology like passengers on a rollercoaster, following a single track through all its plunges and twists.

Such folklore infects much of the current discussion of the American "energy crisis," in which concatenating shortages of coal, oil, gas, and nuclear power, and concern about environmental pollution, have stirred a more lively consciousness of energy's role in our society.

On one side, there are many who stick to the simplistic idea that growth in the national use of energy is good in itself, both a sign of prosperity and indispensable for it. Some prophets of power forecast that demands for electricity, the form in which we take about one-sixth of our energy today, will expand endlessly at 7 per cent per annum.

On the other side, there are people who hold the equally simplistic view that such growth is inherently bad. They accept the prophecies at face value and argue that the rollercoaster must be fought with roadblocks. Like King Canute commanding the waves, they demand that expansion of people's numbers and the demand of each person for goods and energy be halted. Americans, they say, should accept a smaller share of the world's resources, including those consumed for electricity and other forms of energy, and live at a poorer material standard, in hopes that people in poor countries may live better and that man-made alteration of the environment might slow or cease.

The Expanding Range of Choice

But these sorts of simplifications aren't going to help very much in pondering what to do about guaranteeing an ample supply of cheap energy, the indispensable resource needed for freeing the mass of men from subjection to a fortunate few.

As with so many other questions of technology, the problem of energy supplies and controlling their impact on the environment is not one of constriction of choice. The choices are expanding kaleidoscopically. In meeting their energy crises, Americans are not chained to one or even a half-dozen sources of energy, nor are they forced to just a few methods of reducing pollution. In fact, it is more than likely that some methods of energy production which are most attractive for controlling pollution will also turn out to be more efficient than today's best methods.

Nuclear "breeder" reactors and coal-driven magnetohydrodynamic (MHD) power plants are two examples. Breeders not only have the significant advantage of avoiding quick depletion of the fissionable atoms in uranium ore; they also will operate at much higher temperatures than today's reactors, giving promise of considerable gains in thermal efficiency (and reductions in the waste heat burden imposed on nearby waters or the air). In an MHD plant, a violently moving jet of flame within a magnetic field must be laced with an expensive material which can be stripped of electrons. The need to recover the "seed" material should make it relatively easy to recover most pollutants from coal burning, such as sulphur dioxide. After passing from the MHD generator part of the power plant, the jet could still provide large amounts of heat for conventional boilers.

In the folklore of technological inevitability, it is assumed that the multiple energy shortages—which may well leave some schoolrooms unheated this winter and many small electric motors panting for voltage next summer—foreshadow the end of cheap power for this country. Such arguments simply forget about the enormous elasticities in demand for such things as gasoline for cars: supposing prices rose toward European levels because of shortages or taxation imposed to pay for such things as a cleaner internal combustion engine? Would not the trend to smaller cars traveling more miles per gallon accelerate?

Is the whole nation to be air conditioned with window units for each room, many of them running at 115 volts rather than 220? Or will the trend be to larger and more efficient units for entire buildings or neighborhoods, with a better standard of insulation and eventually a leveling of demand when a large fraction of the enclosed volume of the nation has climate control?

Will the requirement for coke per ton of pig iron remain at 1,200 pounds—a requirement that competes with demands for low-sulphur coal—or will it sink to 1,100 pounds or lower in such huge furnaces as the giant blast furnace capable of producing 8,000 tons a day that the Japanese recently started up? And what of the possibilities for more direct reduction plants which bypass the blast furnace?

A Changing View of Supply and Demand

Historically, the price of energy with respect to other goods has been declining, so that today it constitutes less than 4 per cent of the overall value added by manufacture in U.S. industry. The real cost of a unit of electricity to domestic users has been cut in half over the past 20 years, while real income per head has been doubling. Thus, a tripling of the average household electric bill in the past 15 years, the result of an enormous expansion of home electricity use, takes a smaller bite out of an average budget than did the electricity bills of 20 years ago.

It may be, however, that this trend is reversing. Paul W. McCracken, Chairman of President Nixon's Council of Economic Advisers, said in a speech to the Independent Petroleum Association of America in Dallas on November 2 that since 1966 energy consumption had been rising more swiftly than the swiftly rising gross national product, reversing a trend of the previous 50 years. Chiefly responsible, said McCracken, has been a rapid expansion in electric generating capacity.

The trend McCracken was describing may indicate that, in future, a more sophisticated American economy will continue to demand more energy for each unit of economic growth. Yet, it is doubtful that this implies a drastic in-

crease in the cost of energy over the long term, however drastic the price increases have been during the 1970 shortages (when there has been extreme pressure from New England to end entirely the system of U.S. oil import quotas and from utilities in general to restrict exports of coal).

There is competition between different methods of generating power, and there continue to be economies from the scale-up of power-plant size and from sharing of power through expanding "grids" of extra-high-voltage lines, including some very long direct current links. Increasing use is expected of direct current conversion stations to keep the links between power systems strong, by providing a buffer between systems which may be out of electrical phase with each other, as at Eel River in northern New Brunswick.

Also certain to increase is automation of the stock-exchange-like activity of power pool command posts such as the one that opened last February near Albany, N.Y., equipped to take in power from Canada and feed some of it as far west as Michigan.

If we are to believe the projections of Dr. Glenn Seaborg, the co-discoverer of the artificial fissionable element plutonium, fuel costs of power from breeder reactors may be several times below those of today's power plants.

Whatever else the trends show, they make it clear that the relationship between energy demand and other types of demand is not immutable.

Alternatives: The Example of Steel

But if the future is not fixed, then it's conceivable that projections of demand will turn out to be conservative, not inflated. The reasons for this lie more in the industrial sphere, which uses about 35 per cent of the American energy supply, than in the domestic, which uses less than 20 per cent. Although energy costs are a small part of the value added by manufacture in American industry generally, they constitute between 10 and 20 per cent of the costs of certain key industries, such as pulp and paper, iron and steel, cement, and the processing of such nonferrous metals as copper, lead, zinc, and aluminum.

In the metal industries, where the trend is toward exploitation of poorer ores and increased recycling, one can see what might become a much wider pattern for industry and the source for accelerated growth of energy demand. Indeed, it may be that the net effect of environmental concern, with all the expenditures of energy needed to avoid assaulting the environment and for recycling waste products, will be a greater reliance on electric power than would result from simple extrapolation into the future of America's present consumer economy.

To produce a ton of steel today calls for the expenditure of 13 to 15 million kilocalories of energy, and the optimistic calculation of how much this could be reduced by 1980 is about 15 per cent. Although steel production within the United States has held steady at about 550 kilograms per person per year since the end of World War II (another 84 are imported), the fraction of steel produced in electric furnaces has been rising sharply. In 1969, about 20 million tons of steel was poured from electric furnaces, two-thirds of it standard carbon steel. Since open hearth and basic oxygen furnaces each accounted for about 60 million tons last year, electric steel accounted for about 14 per cent of total U.S. production.

Electric furnaces are particularly suited to melting scrap steel, of which there is a great deal. Some 190 kilograms of newly produced steel per person per year is recycled within steel mills before ever leaving the plant, and another 140 kilograms in worn-out cars and other junk finds its way back to steel furnaces. Electric power utilization by the iron and steel industry set a new record each year during the 1960's, rising to 48.4 billion kilowatt hours (out of a total of 1.3 trillion) in 1969.

The steel industry uses energy sources in many other ways. In the blast furnace, where iron ore is reduced to pig iron in the presence of coke and limestone, large amounts of hot carbon monoxide gas are given off and can be burned for such purposes as driving blowers or heating the air that is to be driven through the layers of material in the furnace.

Gases given off by the ovens in which coke is produced from coal by baking yield low-sulphur coal tars and light oils. Demand for coke has been kept high because the new basic oxygen furnaces require a higher percentage of hot metal from the blast furnaces than do open hearths (where coal tars make an excellent fuel). And the use of coal tars as a blast furnace fuel is increasing rapidly, according to an extensive survey of this subject in *Chemical and Engineering News* (September 21).

Here, too, of course, there are elasticities which make forecasting the results of an "energy crisis" pretty risky. Supposing electricity for industry became short, and the mill operators decided to conserve supplies for their rolling mills. They might choose to shut down some or all of their electric furnaces and expend more of their coal tars on running open hearth furnaces which can take more scrap. This would cut down on the amount of coal tars sold outside.

Can Competition Be Regulated?

Although a wealth of such choices is bewildering to the public and the politicians who represent them, it would appear that the fundamental aim of any U.S. energy policy should be to keep the range of choices as wide as possible, to keep the energy sources competing as vigorously as possible to hold the price down. The idea of holding down the price is not so much to fill up the American home with gadgets as to move the economy more swiftly to recycling just about everything that can be recycled.

Keeping the energy horse-race exciting implies a much greater effort in building pilot plants for more efficient combustion of coal at temperatures all the way up to those of an MHD plant, as well as more money for both fast breeder reactors and thermonuclear fusion experiments by the physicists. It implies much more work on the technology of transmitting large blocks of power in both overhead and underground lines and on building the driest possible cooling towers.

On the economic side, it implies federal standards about the gaseous and thermal output of power plants, and the power to set aside sites for power plants long in advance—all this to allow a steady schedule of power plant construction in accordance with environmentalists' concerns.

It also implies a paradoxical policy about economic concentrations in the energy industry. To achieve maximum economies in electric power generation, many experts think there should be consolidation into about 15 huge regional utilities. The present patchwork of interconnections is not enough, it is argued, and more concentration is required.

On the other hand, many of the same observers are concerned about overconcentration on the raw materials side. The major oil producers have always dominated the supply of gas (exploration for new U.S. gas fields has been slowing down) and now are moving into the coal industry in a big way. These "energy companies" also are finding a niche in such nuclear power activities as reprocessing "spent" nuclear fuel. Many people feel that such "energy companies" will erode competition between energy sources, artificially limiting supplies and concentrating on high-profit fuels.

Regulation of the energy industry is evidently going to require a cool eye and a husbanding of will power.

Victor K. McElheny, who contributes regularly in this space to Technology Review, *is Science Editor of* The Boston Globe.

Environments Richer and Poorer, Better and Worse

Architecture as Clavier

Architecture of the Well-tempered Environment
Reyner Banham
London, The Architectural Press and Chicago, the University of Chicago Press, 1969, 295 pp., $15.00

Reviewed by
Kenneth Kaiser
Instructor, Visual and Environmental Studies, Harvard University

Readers of architectural literature are perennially attracted to the words of Reyner Banham much as automobile makers annually flock to the Turin Show. We go to Banham and they to Turin not for prophecies about our respective arts but for tips on what is likely to be the newest twist in fashionability.

Banham has proved his power as a generator of waves of interest in the most unexpected themes; some have been very rewarding, some have not. But all were eminently attractive on first reading. Since the mid-fifties he has "discovered" a dozen dark horse architects, the "Amsterdam School," "Neo-Liberty," the Buttery Hatch, the rolled I-section, Clip-On, Plug-In, the Ring-a-Ding God Box (the new Coventry Cathedral), the American motel, Brutalism, Tom Wolfe, Las Vegas, and the packaged air conditioner.

Among Banham's many gifts is that of the gab. "Stunning journalese," it is called. It's a terse style, accented with an irresistible mixture of jargon and slang, both British and American, that simultaneously exerts snob appeal in America, and anti-snob appeal in Britain.

Banham's books, except for the slim and sound *Guide to Modern Architecture,* are decidedly tricky. His *Theory and Design in the First Machine Age* is after ten years still the basic book on what "really" happened in the teens and twenties—as opposed to what the artists and their publicists say happened. It is basically a doctoral dissertation fortified with a conclusion which issues to architects of the second machine age an ultimatum: either jump on whatever technocratic bandwagon Banham as critic-historian might charter, or be left behind, polishing rosewood napkin rings in a cloud of dust.

Fortunately, conclusions are easy to ignore; one can just stop reading at the next-to-the-last section. The tricky part of *Theory and Design,* however, is what Banham himself omits—namely the impressions on modern design theory left by Hegel, Marx, Spengler, Nietzsche, or "Mazda." In other words, problematic skeletons were avoided by digging down only to a certain depth.

Architecture of the Well-tempered Environment is of a different sort altogether. Here the trick was to get an American charitable foundation to foot the research bills for a book on the history of mechanical air handling and processing, and gas and electric lighting, at just the moment when architects in rare unanimity might reply, "Those are the least of our problems."

Be that as it may, Banham feels that the separation of *structures* from *mechanical services* in the mental habits of architects, as well as in construction management, is the chief deterrent to good building today. Architects have poured energies into refining structures when they should rather have been trying to provide their buildings with decent air and suitable lighting. A quick survey of our libraries will verify the severe imbalance in our attentions. We have shelfloads of books on structure, some of them by builder-engineers like Nervi or Torroja who arrogate the prerogative of structure to the status of a philosophy of design. Indeed, even for architects, this "structuralism" has been a metaphysic-by-default that has surfaced repeatedly in the past few decades as the master discipline of architecture whenever the architects have not had a grip on anything more significant to elevate onto the pedestal.

As Banham points out, no comparable literature on mechanical services exists. They have yet to find a position on the plane of metaphysics. But just give Banham time! Technical handbooks and texts for heating and lighting engineers are supplemented by a handful of essays by concerned architects on natural environmental control. Even these, however, are offshoots of the recent neo-Primitivism kick—the search after the secrets of the Eskimo, Pueblo, Navaho, Berber, or Apulian.

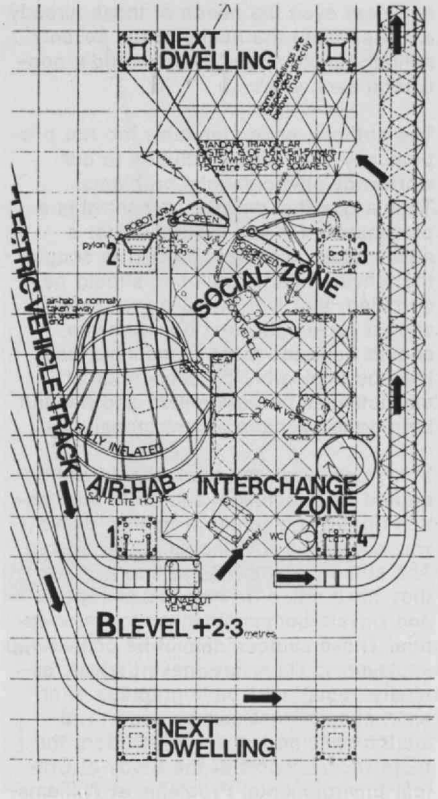
All in all, services have never been a favorite in the popularity race, even though in hard cold dollars the "mechanical" contract often pushes its way up to around 40 per cent of building costs!

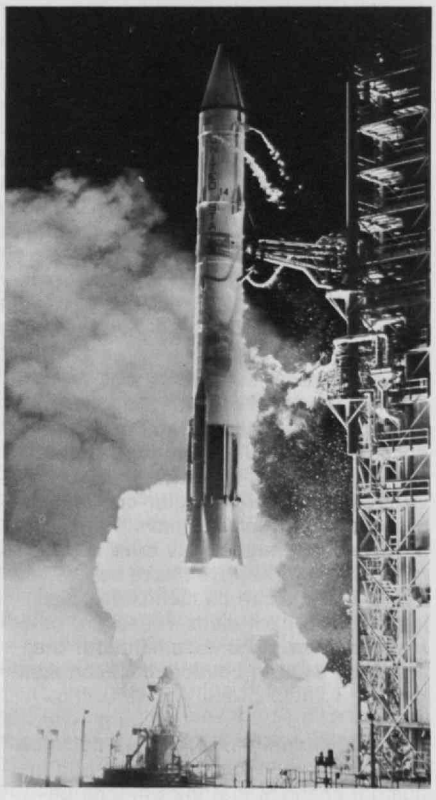
Banham now clearly demonstrates what was only postulated in *Theory and Design.* The "modern movement" of the twenties was, with few exceptions, obtuse and reactionary in the deployment of mechanical services. Lightbulbs and radiators were placed more often where the current rules or vagaries of "composition" dictated—rather than where they might provide glare-free, draught-free service. Likewise, the often published and praised Bauhaus lighting fixtures are here criticized for malfunction. Their form was predicated upon the material and manufacturing processes to be employed, not on the delivery of satisfactory light!

Yet Banham misses an excellent chance to identify and analyze the "aesthetics" of these machine-age ornaments—standard radiators and bare bulbs, exposed pipes and conduits, sockets and outlets. Both for Le Corbusier and for the German proponents of *Sachlichkeit* (actuality or objectivity) these mass-produced standard items were *objets trouvés* for architectural *collages.* They were to possess the Dada, Pop Art magic of non-Art playing the role of Art. This proved to be an in-group game of the professional elite and some bystanding aesthetes—and it fascinated them only briefly. (A very early satire on this game by Evelyn Waugh possibly turned the British wary.)

The buildings of Frank Lloyd Wright are, from the mechanical services point of view, much more to Banham's satisfaction. Wright was a *master concealer* of both structure and mechanical services, but upon thorough examination of the buildings, Wright comes out an important innovator in services, and a man of extremely keen environmental instincts. His "prairie houses" abound in

Reyner Banham, discoverer of architectural movements, antimovements, designers and antidesigners for nearly a generation, has discovered The Environment. In his latest book, reviewed below, he admonishes architects to attend to the environment, i.e. mechanical systems for interior control of air cooling, heat, and light. The Archigram group in London (a previous Banham discovery) has done this by exploring the interfaces between spaces rather than the spaces themselves, as shown in the sketch, below left. Below right is the space age idealization of Banham's idea: the self-supporting interior life environment for astronauts. (Diagram: Architects' Yearbook, *12, 1968)*





quiet refinements in lighting, heating, and ventilation. The Larkin Building in Buffalo (1905), pioneered the use of a mechanical air-processing system integrated with the structure and circulating patterns of the building. This office structure was hermetically sealed against an atmosphere locally polluted by coal-burning locomotives.

Wright's Larkin system proved itself theoretically sound and practically serviceable; but Le Corbusier's sealed and "neutralized" buildings, two decades later, have failed on both scores. Banham finds Le Corbusier's excuses not wholly acceptable.

The monuments Banham has uncovered in the history of progressive air processing can be surprising indeed. The Royal Victoria Hospital of 1903, in Belfast, is a case in point. Post-Victorian by only two years, it is still a visual horror of the first order. But each of its lumps, bumps, and towerlets are functioning parts of a compactly planned organism conforming primarily to the circuits of a fan-driven air distribution system, in which the intake air could be washed, filtered, heated, and humidified as required, to reasonably close tolerances. Here too, local climate problems, together with the requirements of surgeons and patients, forced radical measures.

In the end, Banham is more fascinated by the hardware and gadgetry approach. The American packaged air conditioner exerts a most unusual attraction upon him. Talisman or charm of the future almost, it seems. Banham identifies this standard $150 unit, with its attractively detailed facade of grills and deflectors, knobs and levers, as a *first* in the history of architecture—the *first* commercially viable element of the future Plug-In Environment.

"What about our house trailers? Or derailed diners?" we Americans might protest. Perhaps fashion judgments *are* involved in Banham's choices!

Is he serious or just out to generate a wave of interest? Didn't Banham once amuse us with facetious "iconographic" analysis of the portable transistor radio? Their curiously cutaway leather jackets and their suggestively placed and detailed plug receptacles are surely enough to give this item away as a space-age talisman of more than sonic charm. Just observe their habitual users when next you have a chance! These units appear to work as protective charms when strapped round the neck for a stroll down Main Street, or even serve as amulet messengers of Cupid when taken along down Lovers' Lane. In either usage the initiates evidently feel tuned in to the voice of Big Daddy in the Sky.

But what is the cultural role of the packaged air conditioner? Let's let our fancy run free a moment to 1980, to see if we could get a feel for where Banham might think our world is headed. Inflatable space units for every function from astronaut's suit to exhibition hall: transportable, flexible, repairable, or expendable. Replacing our houses are multi-bubble dwelling units suspended from sky hooks. These are simultaneously pressurized and tempered by the packaged Master Environment conditioner. which will be given a prominent position in the main family-living bubble—assuming the family organization survives till then. But this key package will have a veritable keyboard of controls, for it will heat, cool, filter, dehumidify, oxygenate, and incense the air while emitting cosmetic background-noise, music, time signals, or monitor-coverage of other space bubbles upon keyboard command; it will relay telephone connections, compute accounts, and warn of burglars, pressure loss, or power failure.

On the spot where the Romans had their domestic altar with private cult images and sacred flame of family will whir the master unit of our future well-tempered environment. If Banham is right, may it make sweet music.

Words vs. Facts On Environment

Population, Resources, Environment: Issues in Human Ecology
Paul R. Ehrlich and Anne H. Ehrlich
San Francisco, Freeman, 1970, 383 pp., $8.95

Reviewed by
James J. MacKenzie
Research Associate
Massachusetts Audubon Society

It is often said that the current public interest in "ecology" is a passing fad and will run its course in a few years or less. Such observations reveal a lack of understanding of the nature and sources of our present problems, including the exponential growth that characterizes almost all sectors of human endeavor. In *Population, Resources, Environment* Paul and Anne Ehrlich attempt to give a popular audience a feeling for the nature and complexity of our problems:

"It has been our aim to produce a reasonably comprehensive and reliable sourcebook . . . we hope that the book will provide concerned readers with enough background to enable them to make informed political decisions about environmental issues."

Because of the fame of the authors (their previous book, *The Population Bomb,* has become the basic popular work on population), and their skill at presenting what are at best complicated issues, *Population, Resources, Environment* has been hailed as the "best" of the recent flood of popular environment texts. For this reason I want to raise some questions.

The first seven chapters of this book form a physical-biological description of our general environmental problems. Since the Ehrlichs are physical scientists it is not surprising that these sections are fairly complete. There seem to be few problems that are not touched upon somewhere.

There are, however, several general criticisms which can be raised regarding their style of presentation. What is perhaps most frustrating is their lack of specific references in support of their claims. For example, they state without reference, that the ". . . vast Sahara desert itself is largely manmade, the result of overgrazing, faulty irrigation, deforestation, perhaps combined with a shift in the course of the jet stream." Or, elsewhere, they cite serious side effects from the widespread use of inorganic fertilizers. This is an extremely important issue and should be well documented by technical literature, particularly if we are to make "informed political decisions" on their future use.

There are some statements that seem to be exaggerated. For example, "symptoms of acute poisoning, often experienced by people in traffic jams and on freeways, include headache, loss of vision, decreased muscular coordination, nausea, and abdominal pain." While I am aware that high levels have been monitored on freeways I have never heard of acute carbon monoxide poisoning resulting from them. These and other statements must be documented if they are to be used in political decision making.

The final chapters of this book describe the political, economic, cultural, and industrial changes that the Ehrlichs believe will have to be made to reverse the present trends toward famine, war, and other major environmental catastrophes. It goes without saying that these final six chapters are both subjective in their analysis and controversial in their conclusions.

The Ehrlichs do *not* make the mistake of blaming all of our problems on population growth: "If population growth were halted immediately, virtually all other human problems—poverty, racial tensions, urban blight, environmental decay, warfare—would remain. The situation is best summarized in the statement, 'whatever your cause, it's a lost cause without population control.' "

Their thesis is that a continued growth in population will exacerbate all present social and environmental problems and thereby inhibit any meaningful progress in their solution. Time and again they demonstrate that, given our present political and cultural realities, we cannot meet even the needs of those already alive let alone the needs of the seventy million people added to the world's population each year.

The authors, understandably, do not propose any one, simple solution to our worldwide environmental problems. They argue that population control is a prerequisite for any progress, that a steady-state economy should be sought, that environmental pollution should be curtailed, that worldwide disarmament should be sought, that governments should be made more responsive, and that the ecological consequences of our activities be determined and heeded before the adoption of new technology.

In my own view, the book should not be quoted as a technical source of information on environmental problems, except where explicit documentation is offered. The authors acknowledge that at times they have relied on newspaper reports and private communications for information. These sources cannot be considered as primary. There are, nevertheless, extensive annotated bibliographies after each chapter that can be used to research specific issues. In addition, the more recent report of the Study of Critical Environmental Problems at Williamstown, Mass., last summer, "Man's Impact on the Global Environment," probably represents the most up-to-date thinking on the trends and dangers of environmental contaminants.

Viewed from a distance this book presents a broad view of the interrelatedness of our environmental problems with our cultural, industrial, and governmental institutions. One cannot read it without gradually becoming aware that major changes in the ways we think and live will have to occur, if not today, in the near future.

Although the authors have expressed their opinions on what they believe should be done to start solving these problems, it will ultimately be the task of government, with the participation of an informed public, to determine exactly how and when changes should best be made. It is through books such as this that the public becomes aware of the problems in the first place.

Modern ecological activists claim that the possibilities of man's survival in his ever dirtier environment are limited indeed. But here is a case study of the hunting techniques and culture of the Arctic Eskimo, who still thrives under what are, at best, adverse conditions. Had they been around when the Eskimo first settled in the Arctic, the ecological activists might not have predicted his survival, either. (Photo: Ewing Galloway)

"Eskimo Is a Scientist"

Hunters of the Northern Ice
Richard K. Nelson
University of Chicago Press, 1969,
432 pp., $8.50

Reviewed by
William Fitzhugh,
Department of Anthropology
Smithsonian Institution

It is always a welcome event when an anthropologist writes a book which is important in his own field and also appeals to a wide nonprofessional audience. Richard Nelson's remarkable study of Eskimo ice-hunting techniques, and human adaptations in the Wainwright region of Northwest Alaska accomplishes this dual purpose with insight, versatility, and personal freshness.

Nelson's research (conducted under a U.S.A.F. Aeromedical Laboratory contract to study techniques of human survival in the Arctic) was founded on the premise, first advanced by the Arctic explorer and anthropologist Vilhjalmur Stefansson, that modern techniques for survival in the Arctic logically should be derived from the traditional body of experience developed by the Eskimos. Nelson chose the village of Wainwright for his work since it represented a cross section of the environmental conditions in much of the western Arctic. During the year that he lived with the Wainwright people he actively participated in Eskimo hunting activities and learned their methods firsthand. His data therefore comes largely from personal experience; Eskimo informants and literature review were used as secondary sources.

Despite the orientation of research, the book is not a survival manual. Rather it is a first-rate account of the past and present hunting practices, which have never before been the subject of such intensive observation. Nelson describes the study as a combination of ethnography with ecology and ethology. He considers hunting technology and equipment, the relationships between man and his biological environment, and the behavioral aspects of this interaction. It is this thoroughgoing investigation of hunting adaptations, written from the perspective of human ecology, which gives the work its substance and interest.

The first third of the book is probably the most comprehensive statement that exists concerning techniques of human movement in the treacherous, constantly shifting world of ice.

The majority of the book deals with Eskimo methods of hunting each of the major species of fish, bird, and mammal which inhabit the sea ice environment. Cultural paraphernalia (clothing, camping gear, transportation, and hunting equipment) are discussed, but the greatest attention is paid to the Eskimo method of locating, stalking, killing, and retrieving his quarry. Throughout the narrative, which includes the yearly round of hunting activities, runs the thread of Eskimo knowledge and experience in his environment. "You see," one Eskimo hunter told Nelson, "Eskimo is a scientist."

This aspect of Eskimo culture emerges as a dominant theme throughout the book. In an environment where faulty decisions and actions are so often lethal, the Eskimo has developed an oral tradition and a method of inquiry which serve dually as guardian of past experience and mother of invention. Long winter nights are spent swapping hunting stories and relating experiences passed down through generations by the older hunters. This ancestral legacy, which is accepted unquestioningly by younger hunters, is vitally important when they confront similar experiences suddenly for the first time. Equally important is the Eskimo's method of investigating new problems and of making resourceful adaptations. He learns flexibility and perseverance under stress. The Eskimo instructional system, with its merciless ridicule and veneration of the knowledge of elders, has apparently developed as a very effective method of preserving this vital information. Although Nelson's comments are largely confined to the Wainwright area, he includes enough data from surrounding regions and other areas of the Arctic to give the reader a feeling for the environmental and cultural diversity of the North.

Among Nelson's many contributions are his ideas on the effects of white contact and acculturation. In the Wainwright area, firearms seem to have opened up ice-edge seal hunting, which was previously undeveloped. This in turn seems to have resulted in a marked shift toward larger communities at the points and headlands where ice-edge sealing was best. Earlier, settlements may have been located in bays and protected areas where harpoon hunting was more successful.

Similarly, it would appear that kayaks were used, contrary to popular opinion, more for hunting caribou on the inland lakes than for sealing among the ice, which is a common pattern in the eastern Arctic. With the development of ice-edge hunting, kayaks began to be used to retrieve killed seals and subsequently evolved into the small, deckless retrieval boats common in Northwest Alaska today. These and other aspects of material culture change are enticing areas for further investigation.

Similarly, Arctic scholars will be in-

terested in Nelson's observations on animal ethology, the first significant new body of data in this field since the work of Stefannson (1921) and Degerbol and Freuchen (1935).

Contrary to Stefannson's belief that seals could probably be found in the Arctic Ocean far from shore, Nelson's conclusion, based on existing literature and observations of drift-ice survivors, is that seals are not commonly found in these remote regions.

In addition, Nelson cites evidence from Eskimo tradition regarding the intelligence of the polar bear. This animal is known to hide his conspicuous black nose behind a paw-held shield of ice while stalking sleeping seals. It is possible that the Eskimo shield-hunting technique may have been adopted from observations of the polar bear, although the Eskimo view of the polar bear's cunning might leave room for a reverse explanation! Polar bears have also been observed hurling chunks of ice to drive walruses away from their young, though the question of the bear's ability to kill adult walruses seems to remain open.

This book fulfills its stated purpose very effectively, and there is little that can be said in criticism. However, several points might be made. The organization of material by species is probably necessary but results in some undue repetition. There is also occasional confusion as to whether the author is describing a past or present hunting method (e.g. whaling).

In addition, there is uneven coverage which might only have been improved by more field work. The lack of data on the important whale hunting adaptation—which is the foundation of most recent Eskimo culture—is a striking omission, especially when juxtaposed with the excellent treatment of walrus hunting. There could be more description of ecological relations between species other than man, for these factors affect abundance of certain important staples such as seals. The reader should also remember that many of the hunting techniques used by the Alaskan Eskimos and the behavior of some animals in that area are different from that found in the eastern Arctic. Also, though the scope of the study did not include it, the lack of description of the important Eskimo interior adaptation leaves Nelson's work glaringly one-sided. Finally, Nelson rightfully criticizes the present administrative policies for their damage to traditional value structures, but he does not suggest alternative programs.

With the awakened anthropological interest in environmental studies and human ecology, this book will surely mark a fine contribution to both the general public and the professional. Nelson's book adds rich ethnographic and behavioral detail to our knowledge of "man the hunter," whose evolutionary importance is now widely recognized, from one of the last cultures still actively pursuing the hunter's way of life.

Improbable Feast

The Sea Against Hunger
C. P. Idyll
New York, Thomas Y. Crowell, 1970, $7.95

Reviewed by
John W. Devanney III
Assistant Professor of Naval Architecture
M.I.T.

Upon picking up a book entitled *The Sea Against Hunger,* one's first thought has got to be "here we go again." One immediately expects pictures of gilled frogmen tending their docile flocks of groupers with chemical shepherd crooks, and great submersible vacuum cleaners scooping up millions of tons of phytoplankton—enough to supply the protein needs of a population large enough to squeeze itself to death. However, upon opening this particular book, one is pleasantly disappointed.

This book is, on the whole, a balanced, objective, and extremely informative assessment of the present state of the art and the near-term potential with respect to harvesting the sea. The author obviously has an encyclopedic knowledge of the world's fisheries, and the writing is excellent. I found the description of the present status of aquaculture fascinating—particularly his finding that all the successful examples of aquaculture, of which there is a surprising number, presume an extremely high-priced product. A Japanese shrimp which retails for $4.00/lb. is the extreme, but typical example. It will be extremely difficult to feed the hungry people of the world at that price!

The author also makes the important distinction between the amount of organic material generated by the sea and the amount of economically harvestable sea food. He notes that, even optimistically, the ocean can be expected to supply only 2 or 3 per cent of the world's calorie requirements. This brings us to the protein question.

Perhaps the weakest section of the book, and certainly the only one upon which this reviewer feels qualified to comment in depth, is the refreshingly short chapter on fish protein concentrate. The reader is left with the impression, never quite made explicit, that the case for F.P.C. has been made, and that, as soon as the world recognizes the potential of F.P.C. and learns to eat it, F.P.C. will play a major role in supplying the world's protein requirements. These assumptions can be faulted on several counts.

First, the author makes an *ad hominem* argument to the point that protein is in short supply relative to calories. However, a recent survey by M.I.T. of low-income diets in a number of countries where malnutrition is prevalent indicated that, if everybody received his calorie requirements via his diet, almost everybody would receive sufficient amounts of each of the essential amino acids and nitrogen with which to synthesize the other amino acids, which together form the various proteins. The extremely important exceptions we found are young children and perhaps pregnant and lactating women. Moreover, protein supplementation for calorie-deficient people is relatively ineffective, for much of the protein will be converted into energy rather than tissue. Hence, the primary target for protein supplementation is the young, protein-deficient child who is receiving close to his calorie requirements—a target group considerably smaller than the number of hungry human beings in the world.

Second, as the author points out, "protein requirement" is simply a name covering the human being's needs for certain amounts of a number of amino acids and free nitrogen. The only difference between animal protein and vegetable protein is that they contain the needed amino acids in different proportions. We found that if the calorie requirements of people having protein-deficient diets are met, then they lack only one, at the most two, of the amino acids. Thus, the relevant question for the developing country with respect to protein supplementation becomes, What means of supplying the target group with the additional amounts of different amino acids will cost least? When the problem is looked at this way, it is not clear that these countries should adopt expensive, high quality animal protein. In fact, the M.I.T. study found that at current estimates of the cost of F.P.C. (the author's figures are considerably out of date), and of its alternatives, fish protein concentrate will rarely be competitive with either synthetically produced amino acids or with protein flours derived from oil seeds, even in a fish-rich, currency-poor country.

The problem is that fish at dockside is not only cheap protein, it is also extremely unstable protein. The costs of converting it to a more stable form results in products which, in terms of nutritional efficiency, is more expensive than the alternatives. For example, it pays to feed animals, such as pigs and chickens, who can digest the cheaper and less stable product, fishmeal. But we find ourselves in the odd situation where it pays the fish-rich, protein-poor country to export its fish in the form of fishmeal in return for foreign exchange, a portion of which then goes to purchase synthetic amino acids or oil seed flours to supplement the diets of protein-deficient children. We found that only a substantial decrease in present F.P.C. processing costs could vitiate this conclusion.

In summary, then, this is an excellent book except for its title—which I suspect may have been chosen by the publisher rather than the author—and, except for a somewhat misleading treatment of F.P.C. questions (which I have blown out of proportion in this review!). It is by far the best of its genre and a rewarding book by any standard.

In the minds of many, modern technology has created a monster.

The computer.

We've all heard the stories about people making, say, a $30 purchase. And then being billed for $3,000 by the computer.

Nonsense.

The danger is not that the computer makes mistakes, but that human errors remain uncorrected while the machine rolls on, compounding them.

Computers are literal minded. They must be correctly instructed to help us in the solution of problems. They do exactly what they are told. Not what they ought to have been told.

The computer is man's assistant. Not his replacement.

The unaided human mind needs help to cope successfully with the complexity of our society.

Intellectual aids, such as computers, will not only increase the skill of our minds, but leave more time for human creativity by freeing man of burdensome routine tasks.

Do we really believe that our achievements in space could have been accomplished without computer assistance?

Do we really believe that we can function efficiently in our complex modern environment without computer assistance?

The answer, of course, is obvious.

In truth, the invention of the computer can be compared with the invention of the printing press.

Engineers engaged in the development of computer systems are convinced that over the next decade it is possible to develop networks of interconnected computer systems capable of offering a wide variety of services to the public.

By necessity, one-way mass communications — radio, television—deal with a common denominator of entertainment. This situation can be changed by developing computer-based systems that offer each individual an almost unlimited range of entertainment and information. Each individual will select what he wants, and to how great a depth he wants to delve into the areas in which he is interested.

At his choice of time.

Apply this principle to education.

What it amounts to is individualized instruction. To meet simultaneously the needs of many students.

From a practical standpoint, limits to excellence in education are almost purely economic.

The computer provides a solution by performing high quality instruction for large numbers of students, economically.

Our goal is to make it possible for a teacher to provide individual guidance to many students, instead of few.

Yet, computer-assisted instruction is not a concept which has been enthusiastically embraced by all. There are many who feel that the computer will replace teachers.

Not so.

This interpretation implies mechanizing, rather than personalizing, education.

Everywhere in our lives is the effect and promise of the computer.

Its ability to predict demand makes it possible to apply the economies of mass production to a wide variety of customized products.

It will allow for the use of a computer terminal device for greater efficiency in home shopping and much wider diversity in home entertainment.

It can be a safeguard against the boom and bust cycle of our economy.

In short, the computer means accuracy, efficiency, progress.

The computer affords us the way to store knowledge in a directly usable form—in a way that permits people to apply it without having to master it in detail.

And without the concomitant human delays.

The computer is indicative of our present-day technology —a technology which has advanced to such an extent that man now is capable, literally, of changing his world.

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ARE THEY FOR US OR AGAINST US?

In the early hours of dawn before they left Cambridge, 34 of the 42 cars entered in the 1970 Clean Air Car Race were photographed by Life *magazine in M.I.T.'s Great Court (top); a week later exactly the same number of cars—the survivors of the cross-country test—were photographed in front of the Pasadena City Hall. In the foreground of the M.I.T. picture are most of the members of the C.A.C.R. committee—including (extreme lower right) the author of* Technology Review*'s article, opposite. (Top photo courtesy* Life *magazine—John Zimmerman)*

Wherein a student observer reports how the 1970 Clean Air Car Race proved the tenacity of the internal combustion engine and the durability of the status quo

Bruce S. Schwartz, M.I.T.'72
Official Observer, Clean Air Car Race

Automobile vs. Clean Air

On August 21, 1970, 42 low-pollution vehicles—electric, electric-hybrid, one gas turbine, and many conventional vehicles modified to reduce emissions—left M.I.T. on the first leg of the 1970 Clean Air Car Race (C.A.C.R.). Seven days and 3,600 miles later, 35 of the cars had arrived at the Pasadena campus of the California Institute of Technology. Two electric vehicles straggled in under their own power two days later, bringing the number of survivors to 37. It was a singular caravan—150 motor vehicles (including support cars), 350 persons—which had made its way across America, carrying to all who would listen the message of clean air.

All of the cars were driven—and most had been built—by students from over 20 colleges and two high schools. They were designed to demonstrate the feasibility of building cars that would pollute the atmosphere significantly less than those currently on the road.

This 1970 Intercollegiate Clean Air Car Race was in a very real sense a race against time. Not to see who could make it from Boston to Pasadena first, but to see what kind of power plants and exhaust systems would pollute the air least. The Race was also a challenge thrown at the automobile industry: After all, if students could build low-polluting cars, why couldn't Detroit? Why hadn't Detroit? Though the Race organizers never specifically accused the industry of foot dragging, the accusation was there, implicit in the very fact that anyone felt a need for such a race to exist.

The race against time was and is a race against disaster.

The case against air pollution is by now well established. Mortality statistics, lung cancer and emphysema rates, and the growing physical discomforts reported by urban dwellers only suggest the outlines of the situation—a crisis by even federal standards. In 1966, for example, a temperature inversion began over New York City on Thanksgiving Day; by the time it lifted, 175 persons had died of smog-related causes.

About 60 per cent of the poisons that go into our air come from automobiles. Yet as late as 1965, *Automotive News,* a trade journal, was calling smog "a hoax," a problem only in Los Angeles. In Los Angeles, of course, smog is anything but a hoax. On the day the Clean Air Car Race arrived the radio stations were broadcasting reports of "moderate to heavy smog . . . medium eye irritation." The Angelenos have learned to live, in a manner of speaking, with what is killing them.

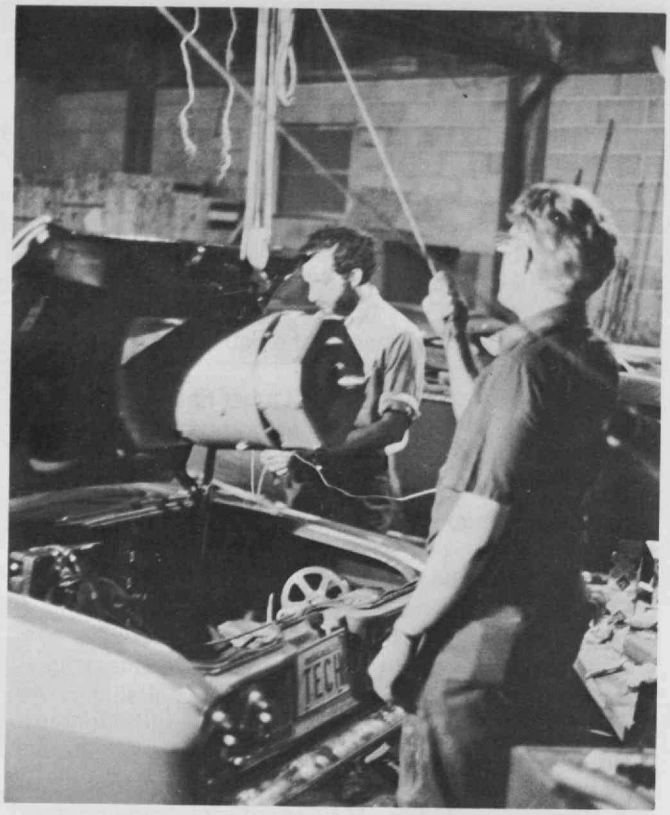
The need for low-pollution motor vehicles was in the minds of M.I.T. Professor Richard D. Thornton and his colleagues last winter when they conceived of the C.A.C.R. as a sequel to the Great Electric Car Race run between M.I.T. and Caltech in the summer of 1968. They envisioned a modest event—perhaps ten cars. It would be open to any kind of power plant so long as its exhaust was clean. It would be run during the summer from M.I.T. to Caltech. They asked Robert G. McGregor, an M.I.T. graduate student in mechanical engineering, to head the organization for the event.

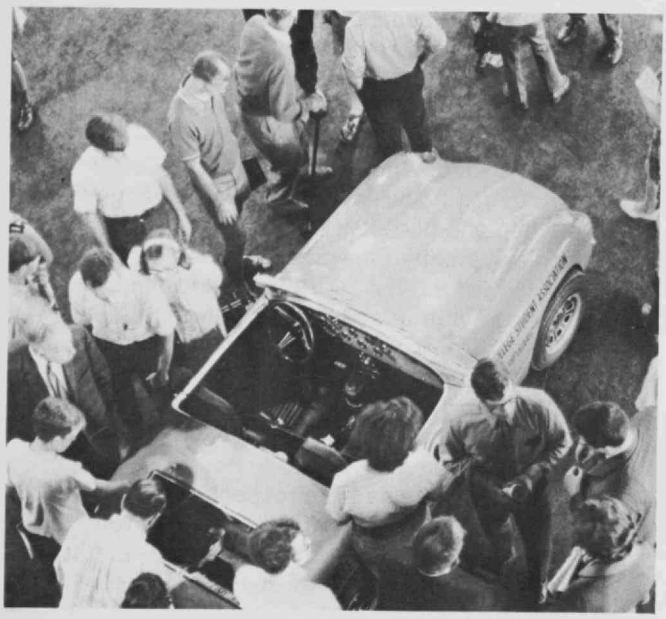
The modest event very rapidly took on the proportions of a logistical nightmare. Though ultimately only 42 vehicles began the race, at one point over 90 preliminary entries had been received by the C.A.C.R. Committee at M.I.T. To help with the organizing, McGregor recruited his wife, his brother, several of his A.T.O. fraternity brothers, friends, and *their* wives and friends. Though primary responsibility was vested in this M.I.T. group, a similar committee at Caltech, headed by Harold Gordon, coordinated planning at the other end of the country.

In a year in which "ecology" seemed to be the word of moment, an effort such as C.A.C.R. could expect to attract a lot of interest. One of the first contacts the Committee made was with the National Air Pollution Control Administration (N.A.P.C.A.), an agency of the Department of Health, Education and Welfare. As soon as the number of potential entries became evident, N.A.P.C.A. began backing C.A.C.R. with a vengeance. On more than one occasion Committee members had to refute implications that the Race was becoming N.A.P.C.A.'s "show." N.A.P.C.A. provided funding for documentation of the Race and ultimately came up with prize money—in the form of $5,000 leasing contracts for the winning vehicles. The leases would cover two months of government testing under the prototype phase of the Federal Clean Car Incentive Program.

Such exuberance seems in retrospect out of all proportion to the mere $3 million the federal government spent on research into automobiles in 1969—a figure whose inadequacy becomes evident when one considers that the C.A.C.R., a student-run event, repre-

A Clean Air Car Race album, top to bottom, left to right: "Miss Purity," the University of Toronto's glamour car, receives a final tune-up at M.I.T.; Georgia Tech's electric car is tested by an unbelieving employee at the Northern Indiana Power and Light Co. recharging location south of Chicago; the Buffalo State College entry attracts attention at an M.I.T. pre-race open house; James R. Killian, Jr., Chairman of the M.I.T. Corporation, and Rene H. Miller, Head of the Department of Aeronautics and Astronautics (right), at the M.I.T. open house; its electric motor goes into the M.I.T. hybrid-electric entry after last-minute refinements before the race; and Miss Purity's enthusiastic audience at a Caltech open house. (Photos: Alan M. Goldberg and Floyd Clark from Caltech)





sented an investment of about $1 million on the part of entrants, their backers, and the Committee and its supporters.

The Politics of Pollution

Throughout the spring and into summer the Committee worked out of its offices at M.I.T., quietly gathering support—a Ford Foundation grant, one from Rockefeller Foundation, gifts from alumni of the Institute and Caltech. The automotive establishment kept an aloof stance. Finally General Motors, one of whose directors is M.I.T. Corporation Chairman James R. Killian, Jr., responded by donating 20 Chevelles and $2,000 per car, to be granted by the Committee to entrants needing them. (The gift came too late for most entrants; the Chevelles wound up as support vehicles while the money went into the test car.) Ford donated the use of its Mobile Emissions Testing Laboratory, and both companies loaned vehicles to the Committee for its purposes. Chrysier and American Motors gave nothing, though the former allowed C.A.C.R. to use its facilities in Detroit for emissions testing. But Detroit was not hastening to endorse the Race.

One exception was provided by Ford's support for a team of its engineers, part-time students at Wayne State University, whose entry was eventually the over-all winner. But this relationship was not publicized. Richard Jeryan, team captain, had a ready explanation. "If we win, it will embarass Ford. We'll have proved that a low-pollution car *is* economically feasible, and then everyone will get after them to build it." Indeed, when Jeryan and his teammates Brian Geraghty, Dan Harmon, and Mike Riley heard of the Race and decided to build an entry, they had to approach the company three times before getting the go-ahead. After writing the C.A.C.R. Committee and having them contact Ford, Jeryan said, they won the approval because a vice-president took the project under his wing.

Jeryan's experience was but a sample of the intricate politics of antipollution the C.A.C.R. had to plow through on its way to Pasadena, and after.

Politics—and technology. The latter was the concern of three of the C.A.C.R. Committee's four published objectives. These were to assess vehicle technology, to determine emission characteristics, and to publish technical reports—"data on vehicle technology and pollution emission characteristics, respectively, in a compact document which delineates the present status of automotive technology." Only the fourth goal, "Create public awareness . . . of current progress in vehicle propulsion plant development and dispel any public misconception of present engineering capabilities," admitted any hint that pollution might be more than a technical problem. Science may be neutral; technology never, for it is governed by the "practical," by the economic and political priorities of those who hold economic and political power. C.A.C.R. demonstrated this in the course of nearly three weeks of testing and racing as much as it demonstrated the effectiveness of exhaust reactors. Before expounding upon this conclusion, however, it is necessary (not to mention informative and entertaining) to return to exposition.

Capitalizing on the National Love Affair

The Committee had a lot to do before the race began on August 24. Rules had to be formulated, a scoring system established, a route planned, arrangements made for testing—and someone had to plot the logistics of getting everyone across the country. Publicity alone required the full-time efforts of M.I.T. junior Frank T. (Ty) Rabe, working with the assistance of the M.I.T. Office of Public Relations. The Race had, in fact, begun to receive press coverage as early as February, when Governer Francis W. Sargent came to M.I.T. to christen Tech II, a lineal descendent of the car that lost the 1968 Electric Car Race.

Anxious that the Race not become a bandwagon for industry—a development which might see student initiative drowned in a splash of big-money cars and high-powered public relations—the Committee decreed that each entrant had to be affiliated with an accredited college (this rule was finally waived for two high school entries) and had to be driven by registered students. A few cars slipped around this rule. Ethyl Corporation's entry, ostensibly Louisiana State's, was built in Detroit and never went near Louisiana. Brunner Engineering of Bedford, Ind., pulled off a publicity coup by entering the only all-girl team in the race, two University of Evansville co-eds who quickly admitted that they didn't know how Brunner's propane vehicle worked.

Entries, the Committee decided, would be judged in five classes, based upon their propulsion systems—internal combustion engines (I.C.E.), Rankine (steam) engines, turbine (Brayton cycle) engines, electric motors, and electric-hybrid power plants—the difference between the latter two being that the "pure" electrics would require external recharging facilities while the hybrids would carry on-board engines powering generators. (These classes were altered after the start of the race since no steam car survived even the first lap. The I.C.E. class was then split.) The winner in each class would be determined on the basis of several tests for emissions, road performance, noise, and thermal efficiency and by its score in the Race. All of these scores would be tabulated each day of the Race by a computer and the results retrieved by the Committee's telephone remote terminal. At the end, a mathematical formula would determine the class winners.

But in naming an overall winner, the Committee desired more flexibility. How, after all, could one compare an electric car with a gas turbine on a purely mathematical basis? There would be economic factors to deal with. The cleanest car might be one that burned liquid hydrogen, but if hydrogen could not be procured in motor-fuel quantities in the near future, such a car could not be considered a practical alternative to today's systems. Would the automobile manufacturers be able to mass-produce steam cars? To weigh such questions would require human judgment, so the Committee decided to leave the selection of an over-all winner to a panel of five recognized "experts" in the field of automobiles and pollution.

Testing: Where the Race Was Won

From an engineering standpoint, the Race was the least

Here is the formula by which winners in each of the six classes of the 1970 Clean Air Car Race were determined:

$S = E(P + R + TE)$

where E and P were scores on emission and performance tests, R the sum of the time scores on the seven legs of the transcontinental race, and TE the thermal efficiency of the vehicles computed in miles per 10^6BTU. The emission score—by far the most complex—was determined from data on hydrocarbon, carbon monoxide, nitrogen oxide, and particulate emissions with engines running and being started while hot and while cold—after standing unused for some period of time. Performance was measured in tests of braking, acceleration power, noise, and handling under conditions simulating urban driving.

The winners and their scores are shown in the table opposite. In addition, a group of automotive and air pollution experts were impanelled to choose an overall winner "on the basis of superior engineering and potential as an answer to the problem of air pollution from automobile exhaust." Their choice was a 1971 Ford Capri modified and entered by students from Wayne State University; it was powered by an internal combustion engine equipped with a fuel-injection afterburner, an exhaust gas recirculator, and four catalytic mufflers to clean the exhaust, and it burned lead-free gasoline.

important aspect of the C.A.C.R. All the relevant data about the cars could have been ascertained by putting them on dynamometers and running them the equivalent of 3,600 miles. The Race was necessary to attract public attention—and hence to achieve the educational purpose—and to attract participants and backers. Exploiting the well-known American fascination with the automobile and with auto racing guaranteed, in theory at least, that the Race would generate enough public interest to be an effective prod to the auto industry.

Technically, however, more important things went on in laboratories in Cambridge, Detroit, and Pasadena than occurred on the road. Michael K. Martin, an M.I.T. junior, was responsible for the emissions tests conducted at these three locations. The tests in Cambridge and Pasadena were done by the continuous sampling method with the car engines previously running—and hence fully warmed up. Each vehicle was put through a seven-phase driving cycle on a dynamometer, and concentrations of pollutants (in this case hydrocarbons (HC), carbon monoxide (CO), nitrogen oxides (NO_x), and particulates) were determined from samples taken at various times during the cycle. The figures were averaged and then multiplied by a rough calculation of the total exhaust volume (based on the weight of the vehicle) to obtain a grams-per-mile figure. Because of its inaccuracy, this sampling method was used only to calculate deterioration between Boston and Pasadena. Thus, a vehicle whose exhaust got dirtier during the race was penalized for it.

The crucial tests were conducted at five locations in Detroit—laboratories operated by Ford, General Motors, Chrysler, Ethyl, and N.A.P.C.A. The instruments were cross-calibrated with standard air samples, and constant-volume sampling was used: the *entire* exhaust volume created during a dynamometer cycle was collected, measured, and diluted with ambient air to a constant volume from which samples were drawn for analysis, giving accurate and direct figures for grams of pollutants per mile. In this case the engines were shut down for four hours prior to test and cold-started during the test, making this a rougher test than the hot-start, since an engine runs dirtiest just after ignition.

The rules theoretically required entrants to prove their ability to meet 1975 federal emission standards (0.5 gm./mi. HC, 11 gm./mi. CO, and 0.9 gm./mi. NO_x). In practice this requirement was waived for most entrants, since many of the cars were finished only days (sometimes hours) before the Race began and could not be thoroughly tested and perfected. Though a majority of the cars beat the 1975 standards in the hot-start tests only seven—no gasoline burner among them—succeeded in all categories in Detroit.

The race itself was a rally; each of the seven legs had its own "best time" based on the Committee's calculations and own driving time each day. The times were based upon strict observance of posted speed limits. The route itself was determined by several constraints: it had to pass south of the Rockies to permit the less powerful electric cars to get through; it had to go through Detroit since only there could enough facilities be obtained to test all the cars. Toronto was made a stopover to give the race an "international" flavor.

Other cities—Champaign, Oklahoma City, Odessa, and Tucson—were chosen for their roughly equidistant locations and their facilities to house, feed, and fuel the caravan. The route was finalized in June and Committee members made several trips to arrange things. These arrangements included the building by utility companies of the nation's first electric highway, a series of recharging stations every 50 to 60 miles. Arrangements were made by the National L-P Gas Association for refueling the 15 entries using propane in I.C.E.'s.

Thermal efficiency in terms of miles per million BTU's was measured over a 1,000-mile stretch of the route between Ann Arbor and Oklahoma City. Performance and noise tests were conducted at the Draper Laboratories' Bedford Flight Facility at Hanscom Field near Lexington, Mass., under the direction of William A. Charles (M.I.T. '71), during the week before the race began.

Winners (below) of the Clean Air Car Race were determined in six classes on the basis of the formula described in the box on the opposite page. In addition, as noted opposite, the Wayne State University entry was selected for special recognition on the basis of its overall performance in all criteria measured during the race.

Class	Type	Winner	Car	Fuel	Scores: Perf.	Race	Emission	Thermal efficiency
I	Internal combustion engine—gaseous fuel	Worcester Polytechnic Institute	1970 Chevrolet Nova ("Propane Gasser")	Liquid propane	698	996	1.70	445
II	Internal combustion engine—liquid fuel	Stanford University	1970 American Motors Gremlin	Methanol	568	997	1.04	819
III	Turbine	Massachusetts Institute of Technology	1970 Chevrolet pick-up	Kerosene			*	
IV	Electric	Cornell University	EFP, Inc.		378	305	0.93	936
V	Hybrid-electric†	Worcester Polytechnic Institute	1970 American Motors Gremlin	Unleaded gasoline	292	562	0.36	672
		University of Toronto	Fabricated	Liquid propane	473	665	0.29	649
VI	Steam°							

* Faulty emissions test results made scoring impossible.
† Two winners were designated because the cars had scores too close to pick one winner fairly.
° No entries in this class completed the race.

To assist with all the testing, and to record the entries' performance during the race itself, the Committee early in August recruited about 50 official observers, of which the author was one. (The observers proved to be one of the weak links in the Committee's planning: in arranging for the legs of the Race to be of such length as to guarantee long hours on the road each day, they neglected to allow enough time at each stop to permit both rest *and* recreation. The human tendency is to choose the latter until exhaustion sets in; thus the observers often wound up sleeping in the cars they were supposed to be watching vigilantly.)

Scarce Technology, Abundant Hoopla

The week at M.I.T. prior to the Race was in some respects more dramatic than the Race itself, for during it the character of the C.A.C.R. was forged: the issues emerged and were defined, the conflicts (explicit and implicit) were limned, personalities emerged, and everyone began picking winners.

In one respect the field of entries that showed up at M.I.T. during the week of August 16 has to be considered disappointing. Internal combustion engines outnumbered all others better than two-to-one. At the finish only five non-I.C.E. vehicles were among the 37 cars that qualified as completing the race. And the overwhelming majority of these cars represented no exciting technological thrusts whatsoever, incorporating into their stock Detroit frames nothing more sophisticated than propane conversion systems that have existed for 20 years, commercially available catalytic reactors, etc.

Several entries stated that their purpose in building their cars had been to demonstrate that a 1975-standard car was feasible with technology available *right now.* One such team, in fact, won its class, with both the best overall score and the best emissions score of any car in the race: Worcester Polytech's "Propane Gasser" surpassed proposed federal *1980* standards on HC and CO, *despite* a 100 per cent increase in HC emissions be-

The cross-country trip was marked by radio interviews (right, the Buffalo State College team upon arrival at the University of Toronto, one day out), public exhibitions (below, in front of Toronto's City Hall), and lonely problems (bottom left, the Cornell electric car recharging in St. Louis). Meanwhile, M.I.T. students manned an information center at the Chicago Museum of Science and Industry, where Frank T. Rabe was interviewed by ABC. (Photos: Robert Lansdale from the University of Toronto, United Press International, and Alan M. Goldberg)

tween Boston and Pasadena.

The fates of the exotic cars were uniformly bad. Steam cars made no showing at all. Working with almost no money save one of the $2,000 G.M. grants, Brunn Roysden's M.I.T. team spent the week before the race working round-the-clock trying to put their jury-rigged fabricated steamer together, but they couldn't beat the deadline for the start. W.P.I.'s "Great Teakettle" arrived at M.I.T. under its own steam, all right, but it was never able to exceed 30 m.p.h. and during testing at Hanscom Field it vented so many fumes into the passenger compartment that its assigned observer was forced to vacate his post. August 24 it was driven over the starting line and back to W.P.I. The University of California at San Diego fared little better: they towed their car back to U.C.S.D. on its trailer, revving it up at the impounds each night to show a curious public what might have been.

Of the pure electric vehicles, only two (Cornell University and Stevens Institute of Technology) managed to complete the race in time to qualify. Their range (60 miles) and long recharging periods (up to 90 minutes) placed them at a hopeless disadvantage as far as keeping up with the Race was concerned. Despite round-the-clock driving, it took them almost 48 hours longer than everyone else to reach Pasadena. Georgia Tech arrived too late. Ironically, they were delayed not by recharging but by their trail vehicle. Georgia Tech's plan was to have two battery packs, using one in their car while the other was being recharged by a generator on the trail truck, which broke down. Three more starters also failed to qualify, victims of a variety of failures.

In the electric-hybrid category, M.I.T.'s Tech II suffered breakdowns even before the start. David A. Saar and William W. Carson, both seniors, hybridized the electric-powered 1968 Corvair which had been to Pasadena in that year's Electric Car Race with an alternator and low-pollution gasoline engine. The alternator burned out and delayed their start for several hours, consumed two days in Toronto being repaired, and failed for the last time in Oklahoma City. The team flew to California in time for the awards banquet; the car was towed back to M.I.T. W.P.I. burned out their solid-state controls but managed to improvise replacements. Toronto's Miss Purity, the flashiest car in the race with a customized fiberglas body, suffered a demolished exhaust line when team captain Douglas Venn drove over a board in Toronto and threw a piston rod near St. Louis—but nevertheless managed to finish the race. Both, moreover, tested out poorly on emissions; and Toronto's quadrimodal machine ran most of the race on its I.C.E. with an electric assist (for acceleration and deceleration).

Finally, M.I.T.'s gas turbine was the standing joke of the Race. Michael L. Bennett's team created an enormously overpowered monster by utilizing a jet-fueled turbine normally used for generating electrical power for flight installations to drive an alternator linked to a 600-h.p. electric motor. Its noise was painful; its thermal efficiency one-quarter that of the next worst entry; and the volume and velocity of its exhaust was such that no way could be found to sample it.

In the midst of the hoopla no one seemed to mind the fact that no one demonstrated any really innovative technology. There is, of course, a simple explanation: it is far easier to modify an already sophisticated package than to start from scratch, and the state of steam and electric car technology is such that this is what most entrants chose to do—and without the kind of money or time required for research to create a product which would fulfill the demands of a transcontinental journey. In this respect the C.A.C.R. failed—was doomed to fail. This is tragic; there *are* some reasonable alternatives to the I.C.E., and they need to be explored. For example the Rankine cycle (steam) engine is not only inherently cleaner than the I.C.E. by virtue of its external combustion; it is mechanically far simpler. (Is this mechanical simplicity a clue as to one reason the automobile industry has been so reluctant to develop the steam car? Replacement parts account for a large fraction of the industry's business.)

During the pre-Race week the corporate stakes in automobile pollution and its solutions could be appraised by a casual perusal of the literature in the "industrial" press room, set up separately at M.I.T. to emphasize the difference between the student and industry roles.

One packet in the industrial press room touted the virtues of liquid-propane (L-P) gas as a motor fuel. A similar one extolled natural gas. A third advertised the Engelhard platinum-coated exhaust gas reactor, a catalytic device used by nearly 20 entries. (Reactors are basically chambers mounted in the exhaust line back of the manifold, in which reactions begun in the engine may continue, oxidizing unburned hydrocarbons and CO. Some work by keeping temperatures at engine levels; the Engelhard utilizes a honeycomb material coated with platinum, which acts as a catalyst.) The Engelhards ironically represented the main threat to another corporation represented in the room—Ethyl, whose principal product, tetraethyl lead (the market is shared with du Pont) ruins the catalyst in catalytic reactors. This, and the fact that lead itself is poisonous, is at the root of the current move to eliminate lead in motor fuels. Ethyl's Louisiana State University entry pointedly burned leaded gasoline and carried a lead particulate trap in its exhaust system. Just in case, however, Ethyl's literature pointed out that current lead concentrations in the atmosphere are considered "acceptable"—i.e., no observable symptoms of lead poisoning have been noted from automotive sources. The L.S.U. car, incidentally, failed to meet the 1975 standards in HC and NO_x.

Student groups who entered I.C.E.'s in the Race chose a variety of design modifications to reduce the inherent pollution, including:

◇ Changing the fuel. Besides L-P and natural gas, methanol and unleaded gasolines were used. All required changes in carburetion.
◇ Running "lean." By increasing the air/fuel ratio, more complete combustion can be achieved—at the sacrifice of some power.

◇ Advancing spark timing and lowering compression ratios. Both reduce cylinder temperatures (and so reduce NO_x formation) and promote longer burns in the cylinders with less incomplete combustion products in the exhaust.
◇ Fuel injection. Electronic monitoring ensures maintenance of exact fuel supply to the cylinders, preventing overcharges of fuel with resultant waste fumes.
◇ Exhaust gas recirculation.
◇ Catalytic reactors. Every winning vehicle except M.I.T.'s gas turbine was equipped with catalytic reactors to collect and transform the emissions.

Some of the gasoline burners sealed their tanks, even though evaporative emissions were not being tested by C.A.C.R. Several entries also stripped their cars, to put less load on the engine. (One thing the C.A.C.R. demonstrated, to no one's surprise, is that compact cars get about twice the fuel mileage of standard automobiles.)

The Race Became the World

The racers stepped into the full glare of publicity on August 22, when the first of many public exhibitions—this one at Boston's Museum of Science—attracted a moderate crowd who pumped the team members eagerly for information. Here, as at every exhibit along the route, the showstopper was Toronto's Miss Purity. She had a twenty-first-century body, the kind you see only in Sunday supplements, and her crowd-drawing powers made you wonder almost as much about Detroit's designers and their talents as about Detroit's engineers and executives.

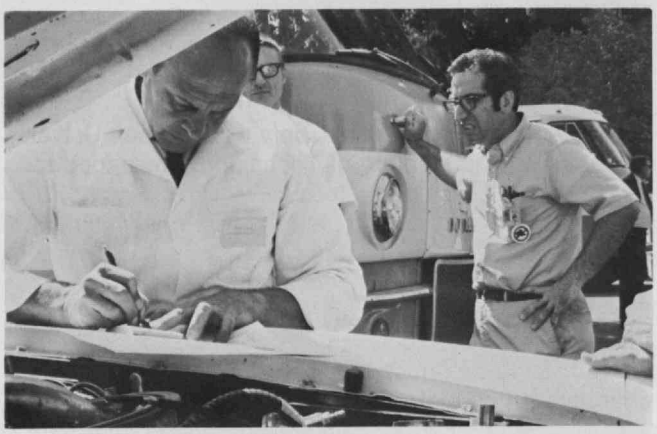
The first cars left at 3:30 the following morning. The six electric entries and an electric motorcycle from a California high school (ineligible to compete because the rules required four wheels, but they were allowed to travel as participants) were given a three-hour lead on the other cars. Nevertheless by the time Monday ended they had fallen behind and would continue to do so.

Readers may wonder why I have chosen to dwell so little on the race itself. The answer is that in retrospect the race is unimportant beside the magnitude of the issues it raises. While we were on the road, however, the race was overwhelmingly significant; in fact, it was the only thing of significance in the world, and it became the world to the participants. We were in the cars up to 14 hours a day; in the evenings team members had to stand at the impounds and explain matters to the public. There were meetings and press conferences to attend. Several cities honored us with public fetes, buffets, and barbecues. A lot of liquor was consumed. A lot of sleep was missed.

Our badges made us known, welcome, and subject to interrogation almost everywhere—including truck stops and expressway rest areas. But our welcome did not include Disneyland, which refused to admit Michael Bennett's M.I.T. team because of their long hair—Disneyland having been invaded by Yippies waving N.L.F. flags three weeks before.

Entries, support vehicles, committee, observers, two film

At the end of the week's transcontinental sprint, there was more emission testing at the California Institute of Technology; a smile from Richard Jeryan, team captain of the grand award winner Wayne State University; and congratulations from California's Lieutenant Governor at the Awards Banquet in the Caltech Athenaeum. (Photos: Floyd Clark from Caltech and Alan M. Goldberg)



crews, and a couple of newspapermen—in all over 350 people and 150 vehicles. Amazingly, there were no accidents whatsoever, not even a dented fender. There were few incidents. Whitworth College was stopped and ticketed for speeding in Arizona. A cameraman was arrested and fined $50 in Montonee, Ill., for sitting on the tailgate of the crew's station wagon—parked at the time—drinking a beer, an act which is illegal in Illinois. Otherwise the Race repeated itself every day; one newspaper correspondent began a dispatch with "It was a dull day . . ."

In Pasadena the finishers were retested and redisplayed and the winners announced; the winning teams departed with their trophies and N.A.P.C.A. with their cars. The overall winners, Wayne State, were surprised by their victory. They had "blown the Detroit tests," said Richard Jeryan, "because of a faulty setting on the manual choke." A retest in Pasadena had convinced the judges that the Caprang, a modified Capri burning lead-sterile gasoline (gasoline marketed as "unleaded" may contain traces of lead) and using catalytic reactors, was in fact capable of beating the 1975 standards—perhaps even the proposed 1980 standards, as Jeryan claimed.

In giving the overall prize to Wayne State, the judges passed over a number of nongasoline automobiles that *had* tested out better. One of the reasons they did so, explained their chairman, David Ragone, Dean of Dartmouth's Thayer School of Engineering, was because of the "practicality" of sticking with a gasoline engine. In this the judges' decision is consistent with the inherent indolence of the American economy and the industry which it represents. The automobile and its internal combustion engine are highly perfected machines in which we have a large financial and emotional investment. Developing alternatives to a similar state of perfection will be expensive and may be impossible. The automobile industry is not surprisingly uneasy about sweeping changes in an eminently profitable status quo. N.A.P.C.A. has expressed similar sentiments, though the agency is said to like the electric hybrid for the long run since it could be run pollution-free within city limits. Neither business nor the government wants to rock the corporate boat if pollution can be dealt with without such drastic measures as totally banning the I.C.E. in 1975 as has been suggested by the California Senate and Senator Edward Muskie. The question is just how long the solution will be delayed by this kind of conservatism.

Gordon J. F. MacDonald of the President's Council on Environmental Quality, who was the keynote speaker at the send-off banquet at M.I.T. on Sunday evening, August 23, touched upon the real issues—traffic congestion and the need for mass transit, the social destruction wrought by the automobile and its highways, the waste of metals represented by the nation's scrapyards and of humans by our accident toll, and the economics of pollution: ". . . It is often cheaper to pollute the environment than to protect it. The polluter's indifference gives him a competitive edge over his competition and he is more likely to survive. I believe that some basic restructuring of our system of economic incentives will be necessary if we plan a long tenancy of the earth."

Though such issues were discussed at C.A.C.R. seminars and by participants, little of them reached the nation's press. Indeed, the press was all but obsessed with the superficial aspects of the race: who came in first, what the girls were doing, etc. Most press coverage consisted of little more than enthusiastic gushing. Only a handful of reporters were critical at all, and only one —*The Wall Street Journal*—printed anything uncomplimentary. Almost without exception, the C.A.C.R. was in fact used to give the impression that somebody *is* doing something about pollution. The Race's organizers and spokesmen in their public statements chose to play down the dissatisfaction with the automobile industry which had inspired the Race in the first place, and by failing to do so they lost an opportunity to arouse public opinion to pressure the industry for a low-pollution car. Let us suppose that when the Race Committee had the ear of the public it had said, "If we can do it Detroit can do it. Demand it from them. Tell them you'll buy foreign cars if they don't give you a clean car by 1975. Your air is killing you!" Just suppose.

Inadvertently, the Race Committee allowed the C.A.C.R. to become a bit of a soap box for industry, by setting rules and standards which made it easy for casual observors to assume that Detroit is working harmoniously with the students and will soon have a solution on the market. That is a pity, for the race *did* in fact produce some cars which *did* beat the 1975 standards, and did it in a relatively inexpensive manner. Of course, these cars weren't tested after 50,000 miles. They were not tested after use and abuse by average drivers. They were tested on a California driving cycle, which, it turns out, does not reflect the way cars are driven and the way they pollute in New York. C.A.C.R.'s performance tests are misleading because they depended as much on the skills of the drivers as upon the integrity of the cars. But the Race Committee started with a modest intercollegiate contest and ended up with the *grand prix* of antipollution. They started from scratch and operated in the dark. No one had ever run a Clean Air Car Race before; in fact, no one had even tested particulate emissions before. That is how primitive our antipollution technology is at this point.

Many criticisms can and will be made of the C.A.C.R. But in an otherwise smoggy summer it was a ray of hope. Whether the clouds are breaking up we shall know in the years to come.

Suggested Readings

John C. Esposito, *Vanishing Air.* New York: Grossman Publishers, 1970.

Bruce S. Schwartz came to M.I.T. from Camden, N.J., to study architecture in September, 1968; his plans have since changed, and he is now studying in the Department of Humanities while completing various free-lance writing assignments such as this one for Technology Review. *He has been a member of* The Tech, *M.I.T. undergraduate newspaper, and of the staff of* The Phoenix, *a weekly Boston-area newspaper.*

For every college student, registration day marks the first experience with a process by which he separates the formal goals of a professional curriculum and the means by which he will attain high grades and other academic rewards; hence the author's concept of the "hidden curriculum." And hence his questions: "Can the educational environment lock some or many or all students into a narrow and rigid adaptive response? Do students in the process of becoming highly competent in some academic discipline or in a profession increase the risk of a rigid response?"

Universities and their students, confronted by rapid change in both social and technological environment, must learn to be truly flexible, not simply adjustable. Can we thus escape the lemmings' fate?

Dr. Benson R. Snyder*
Dean for Institute Relations, M.I.T.

The Ecological Trap

Lemmings provide a dramatic example of an ecological trap where a species has outstripped its means for managing to live in some proximate equilibrium with its environment. The lemming population increases geometrically under the frozen tundra of a peninsula; every three or four years, a point is reached at which there are just too many lemmings in the available space, and they start their race to the sea. The lemmings' ability to adapt has not kept pace with their changed circumstances. They are caught in an ecological trap set, at least in part, by themselves.

We know examples of other ecological traps: New England ponds or Lake Erie; even the Los Angeles freeway may be one. The point is the same. Habitats and living conditions change, whether by increases in population or by the intervention of man or other external agencies. This upsets the equilibria and puts a strain on the organism involved. The organism can adapt (though there are limits), but it can also panic or, alternatively, ignore the strain. Both of these responses decrease the organism's ability to see his surroundings and thus contribute further to the environmental strain.

Higher education may well be facing an analogous crisis. The way in which the universities deal with the mounting distraction will shape them two decades hence.

Sir Geoffrey Vickers, a most perceptive observer of the British and American social scene, draws on the ecological imagery and further extends the relevance of the metaphor: "We now seem to be approaching a point at which the changes generated within a single generation may render inept for the future the skills, the institutions, and the ideas which formed that generation's principal heritage."

If Vickers is correct, if the analogy with the lemmings has any force, then within higher education students and faculty now need to examine seriously their current assumptions about their activities and institutions and check them against the present reality. Our patterns of governance and our processes of education no longer rest on wide agreement among almost all participants about the nature of the enterprise. An approximate consensus on the goals of education in this country and on the means to those goals can no longer be assumed. Our fathers' values and assumptions are no longer self-evident to our sons. The loss of this consensus is a profoundly important social and psychological event. It is a symptom of the "changes generated within a single generation."

There are other effects of this altered circumstance: increasing polarization of positions and growing distrust —both leading to increasing strain on the "normal" channels of communication in the classroom and in the governing committees of universities.

Technological Change as an Ecological Trap

There are special problems in a university which is both contributing to and profoundly affected by the very rapid growth of scientific and technological knowledge. For example, the working circumstances of an optical engineer have altered drastically within the last decade. Until recently a lens of any complexity was the product of months of trial-and-error calculations. A computer now makes these computations in a matter of seconds. The optical engineer who obtained this accuracy through long periods of tedium and hard work finds this talent far less necessary and possibly even irrelevant to the new tasks that now face him. It can be argued that his previously successful adaptation to tedium had become so much a part of his sense of competence as an optical engineer that he would be psychologically unable to shift his cognitive style to one more consistent with the new tasks.

Can the educational environment lock some or many or all students into a narrow and rigid adaptive response? Do students in the process of becoming highly competent in some academic discipline or in a profession increase the risk of a rigid response? Are there educational contexts that extend, rather than limit, the students' range of adaptive responses? Precisely the same questions can be asked of the faculty.

In the complexity of this post-computer world, my answer to these questions is not to give up on competence. Man's survival rests in part on greater competence, not less. But we must be clear about those linkages, processes, and interactions between students and their surroundings which free or, alternatively,

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severely limit their adaptive potential while they are learning a skill or discipline.

This latter outcome, if or where it occurs, can be viewed as the ecological trap of today's higher education. A student who makes an immediate, successful adjustment, such as mastery of the skill or even a high grade-point average, may achieve the feat in a manner that limits the possibility of shifting his adaptive style. Ecological traps develop where such longer-term consequences have been ignored, though to know about or anticipate these consequences is not an easy matter. A student (as well as his professor) may become locked into one view of man and come to base his sense of worth on one way of formulating complex social problems. He may misread or fail to read the evidence that would suggest some error in his view.

To put the issue another way: in the very process of achieving a set of interrelated educational objectives, a number of students appear to develop both cognitive and adaptive styles which then become so fixed that their ability to cope with new tasks or with altered circumstances may be severely limited. This may be the price that has been paid by the student for a parochial or short-term success in education. Some very able students maintain their high grade-point averages by closing themselves off from other activities (consulting source books) and from feelings (curiosity; delighted derivation of formulae; excitement over the Lorenz transformation; writing poetry, etc.) which they consider irrelevant to the completion of what they have come to see as their immediate educational task—passing the next quiz or handing in tomorrow's problem set.

So this rapid rate of social and technological change has made visible a question that in the not-so-distant past we could largely ignore. We must come to understand what it takes intellectually and emotionally for students to complete the assigned tasks of the modern university. We must look beyond the formal curriculum in order to determine which tasks are relevant to the students' survival.

In this effort we quickly discover that there is a difference between the messages a student receives from his teachers and their curriculum and those he receives from the means he finds must be used to attain high grades and other academic rewards. As a student moves from one class to the next, listens to professors outline assignments and quizzes, laboratory work and term papers, he comes to sense that the faculty expect him to acquire certain information and to develop enough competence to work problems in physics, take tests in history, or write a theme in English. In practice this is almost always translated by the student into a series of discrete, more or less manageable tasks which he infers will be the actual basis for the grade his professor will give him. The question is not only what he will learn but how he will learn, and the covert, inferred tasks—and the means to their mastery—are linked together in a hidden curriculum. On many campuses, for example, students find that only part of the assigned work really needs to be completed; this discovery is usually their initial experience with the dissonance between the formal curriculum and the hidden curriculum.

Adaptation to Distraction

There is ample evidence that on many campuses the same teachers who claim they want creative students so burden them with busy work that the students have almost no time left to explore the limits of their newfound competence or to test or extend its relevance to their reality. Distraction has been institutionalized for both faculty and students, and managing this distraction becomes the first assignment, a matter of sheer survival for both faculty and students.

The kinds of pressures represented by institutionalized distraction, generated in part in the society outside the university, come to exert a significant effect on the hidden curriculum and, in turn, on the formal curriculum. It is also a pressure that has a considerable influence on the life styles of faculties and students, on those forms of adaptive response which become sanctioned on each particular campus.

For example, students request increasingly more and more of their faculties' time and attention. Such students perceive that their education is less than it could or should be because of their too limited contact with the faculty. They often seek to initiate social activities involving their professors; they ask for smaller classes or tutorials. Ironically, the students' education may in fact be even more endangered by such requests unless the underlying problem of distraction is also dealt with. For without some alteration in the faculty's commitments of time and energy, the faculty, faced with still

another encroachment, may rely even more on institutional processes to protect them. The lecture and the quiz conserve the professors' time while furthering (at least to some extent) the students' education. A program for the faculty to know their students better, without a change in the conditions that exist in most universities, is unlikely to gain more than a token response. Such requests are in fact yet another distraction.

What would cause more frequent and meaningful encounters between faculty and students that would not be a distraction for the faculty? In England the nurturing, the "care" of young men by older men has been as much the source of self-esteem as scholarship for some faculty. We can rarely create the conditions of elite residential Oxbridge Colleges, but we do need to find ways for faculty and students to come together in learning situations where they both have a significant stake in the work at hand and in the outcome. Student employment in the professor's laboratory may result in such an opportunity. Courses centering on real and pressing problems (pollution, voter registration, arms control, etc.), developed and even taught jointly by faculty and students, may provide another situation where students and faculty can have common purpose. The encounters must be regarded as legitimate by all participants.

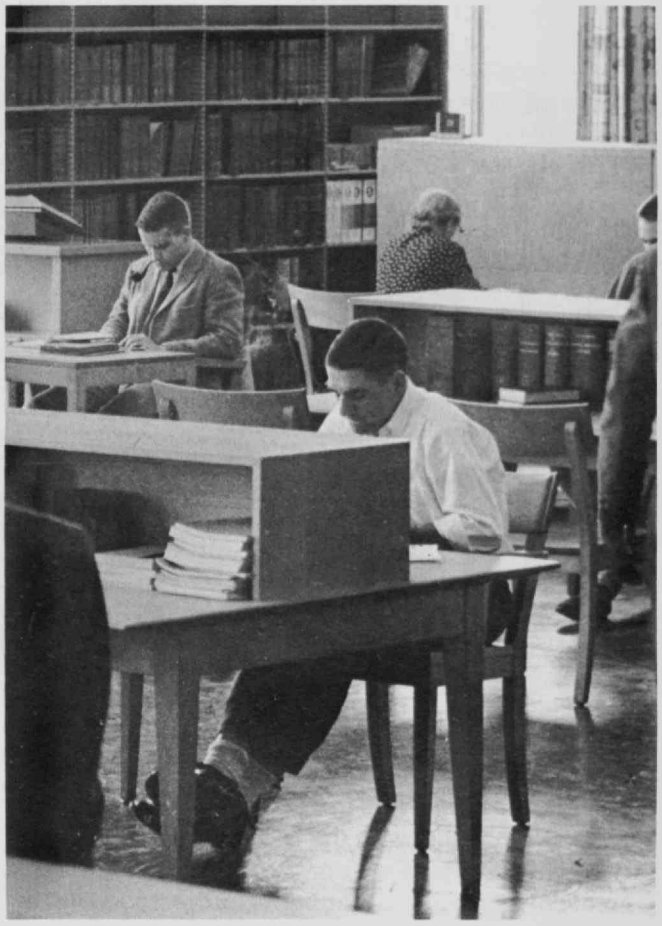
Students as well as faculty are faced with institutionalized distraction; both are prisoners in the same box. The students' descriptions of what it feels like to be inside often coincide with the faculties' accounts. Both feel forced to make the most efficient use of their time. The general emphasis on "efficient communication" often seems to lead students and faculty to ignore signals from each other that in a narrow, short-term sense have been defined as distracting. Ambiguous cues usually need careful attention to decode and then to understand; under pressure they may simply be shut out or become the only object of attention at the expense of any goal. The classic example is the professor who says "Be creative" and rewards rote memory. The closer people come together, the more essential it is to understand these cues in an interpersonal relationship. This particular response to distraction—reliance on simple, unambiguous cues—does pose a potential threat to education; it denies the inherent complexity of life.

Consider the potential appeal for a student when he is told by a colleague (either faculty member or student) that he should ignore subtlety lest he be penalized or co-opted. The more simple and direct the appeal the more it may serve to diminish distraction (the self-righteous certainty that so often accompanies such appeals becomes a further protection). The stage is then set for political solutions to the problems of education, in a setting where the effect of those solutions on the quality and kind of education will probably go unexamined, except by a few suspect social scientists.

Several years ago, when I was interviewing a number of students in one institution, some of these students described the university as cold and impersonal and then went on to say that they had stopped dating and avoided bull sessions because both were "distractions." They

"I mean it's nice to go through with straight A's and sure people look at your record. Yet, I know inwardly this really isn't the thing that counts. I'm not that much smarter than the other guys in my class. Maybe I saw some tricks. I know an awful lot of people who go through with straight A's that are awfully dull people, that haven't really learned what's in the courses or how to approach things.

"I've talked about beating the game, and yet I think in one way you can't underestimate (that) beating the clock aspect is a valid educational experience. You know, the ability to quickly run through a whole mess of facts and pick out the important thing."



had become impersonal in order to "maximize" their time, as one student put it. So their response to the press of distraction was to become cold and impersonal themselves. They didn't perceive that the faculty were caught in the same trap and that they too became impersonal as a way of dealing with increased distraction.

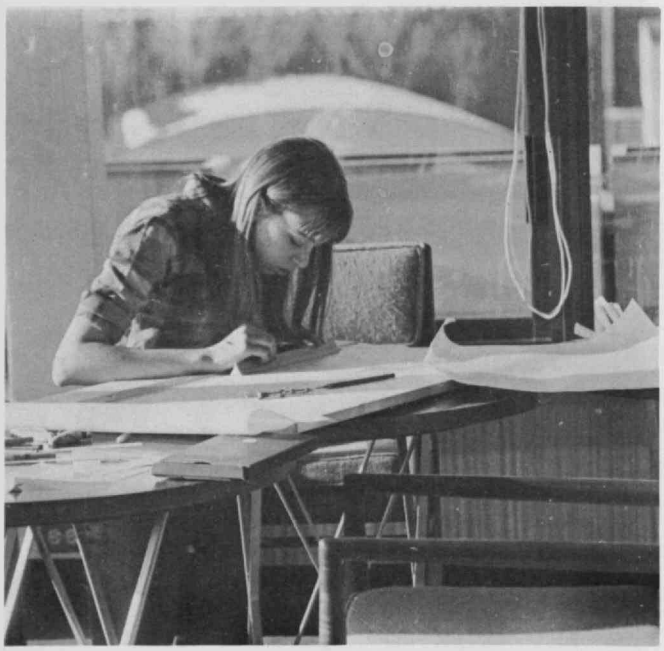
There are implications for "successful adaptation" in the cognitive models and life styles that students and faculty develop in order to organize and comprehend their experience in higher education. This is particularly so since these models serve as both the students' and faculty's means for sorting out the signals from the noise around them. (Students who do not go to class are "lazy.") They use them to help deal with the dissonance on campus, to decode the mixed messages of faculty and student intent as expressed in the two curricula. These models, with their latent assumptions about how and why students learn or teachers teach, may be expressed covertly in long-range plans and judgments about higher education. The model becomes the basis for major educational programs, for the grading structure in most colleges.

The risk of obsolescence, however, is great. The individual who has tied his sense of worth to the "correctness" of his model may not be able to read unanticipated, new cues from his environment that would have signaled a change in his educational or social circumstances. Such an individual would have no inclination to know that both his "model" and the adaptive position that it suggested had become "out of phase."

There is a point at which a particular adjustment to a given set of environmental pressures may become irreversible. The adaptive pattern that has become fixed is less likely to be responsive to further changes in the environment. The optical engineer's obsessional attention to detail and the dinosaur's weight and size, developed over a millennium to cope with a piece of earth and other dinosaurs, became their undoing when confronted with a change in the conditions for their survival.

"From the beginning I found the whole thing to be a kind of exercise in time budgeting. I found during my first year that I was very worried about it not being possible to do everything that every course asked you to do. You had to filter out what was really important in each course, regardless of whether you were worried about the grade or not. You couldn't physically do it all. I found out that if you did a good job of filtering out what was important you could do well enough to do well in every course.

"I like to think that those professors knew very well what they were doing, that they knew very well that the people weren't going to do it all, but were offering the stuff as a guide to what you might do."



"I put a lot of time into the course and I really liked it, but I got a C. I suspect maybe I wasn't original enough in my answers in the quizzes, or maybe they were original and were the wrong ones. Seriously, I liked the course and I don't know why I got the C; I mean, I worked and I thought I understood a lot of it. But I didn't quite cut the mustard in the test."

The Ecological Perspective

Unlike lemmings, man is complex and able to survive extreme stress, at least for the short term. But the stresses and the pressures in education are subtle and operate insidiously. Man may not know until too late that he has paid a high price for his immediate adjustment to these stresses. The physician who gives the coal miner elixir of terpinhydrate for his cough has relieved the symptom of the lungs' reaction to inhaled irritants. Their effect on the lungs may not become clinically evident until years later. Attenuating the symptom has obscured temporarily the underlying pathological process. Similarly, a counseling service at a college may direct its efforts toward adjusting students to the local conditions, reassuring them, supporting them in their immediate distress, and fail to consider, like the miner's physician, the cost of short-term fitting in to the student, or to society a decade hence.

One major gain from an ecological perspective lies in its emphasis on complexity, on the interdependence of man and his surroundings. Such a perspective high-

lights the specific accommodation made by a species (or an individual of that species) to the constraints, the limits imposed by its environment.

We have found repeatedly at M.I.T. that when a student's sense of his worth is based principally on those narrow ranges of criteria of performance that are used by the institution, two things follow. First, the student's adaptation appears to be less likely to change, even in the face of new and different environmental pressures. Second, the student also appears to be less aware of the consequences of having adjusted than are his classmates. To fit the real diversity of students we may not need to teach them differently; we may just need to grade them differently.

Adaptive Students vs. Piecemeal Reform

As part of research on these issues undertaken at M.I.T. by the author, two groups of students were selected on the basis of their scores on a psychological test given to them early in their freshman year. We were interested in seeing whether students with similar adaptive patterns had similar academic fates as they moved through the institution. One group were chosen because they were marked by a desire to seek out new, complex social and cognitive experiences. The other group's responses to the same items in the personality inventory suggested that they were careful, orderly, avoided ambiguity where they could, and appeared to take minimal risks. The group seeking new experiences lost three times as many students through withdrawal or disqualification as the non-risk-takers in the first year, with no significant difference in subsequent years. Moreover, the grade average for these latter students was consistently higher, despite the fact that there was no statistically significant difference in the results of the scholastic aptitude and achievement tests of the two groups on admission.

Over the four years about a third of the students from the risk-taking group left the institution. The restless curiosity which characterized them is a quality that many faculty members desire in students. So the institution wanted these students, admitted them, and saw many of them leave. Indeed, we have been suggesting that it unwittingly forced them out.

Some faculty members argued that the admissions procedure was lax since so many of this group failed or withdrew. The argument seemed to be that the institution should admit students who would survive, with the assumption that the environment could not or should not change. Had the institution followed this course of action, it would have lost the opportunity to learn about some of the major costs of its tightly scheduled, competitive first year, plus the personal cost of the failing students. More serious, it would have decided to select students to fit a maladaptive program. That it did not do this is reflected in a major reform of the first-year curriculum still in progress.

One professor in a science department restructured his recitation section of a required course in order to engage the more creative students in a dialogue and to free them from the possible tyranny of extensive assignments. He limited the number of students to 12, instead of the usual 20 to 24. They sat around a table in a comfortable room; the discussion, like the surroundings, was far less structured than in most such sections. But the attendance of the creative students dropped off, while their more conservative classmates came regularly throughout the semester. The professor felt that his experiment was, by and large, a failure. But since the absent students did well enough academically, only the professor was directly concerned about these students and his experiment.

This experiment was embedded in an intensely demanding curriculum. Many who cut class were simply responding to the pressure to produce in their other subjects. Blinding themselves to the syllabus and working by the clock did not come as naturally to the creative students; it took, as one student put it, "constant vigilance to keep up." He hoped that after graduation there would be time to pursue the intriguing questions that he had heard raised in his few appearances at the seminar. For the present he had to ignore the questions and the seminar in order to make the time to keep up his grades.

Thus institutional pressures deprived both professor and students of the dialogue that the design of the section was intended to sustain. Most of the students reported in some detail how hard they had worked. Several of the "dropouts" said they had missed a real engagement with the subject even though they had mastered its syllabus.

The language and the imagery used by many of the faculty in this department to explain their educational philosophy is relevant. A department paper described the acquisition of knowledge as a "linear function between native intelligence and work." That is, the harder one worked, the more one learned. This value, held by both faculty members and students in one institution, caused the failure of an experiment in a single course; this is perhaps the characteristic fate of piecemeal rather than structural reform in education.

At present our evidence is only suggestive, but it appears that many otherwise well-qualified students whose cognitive style is concrete leave physics after their experience with relativity theory, perplexed and uncertain of what they have been dealing with. In the context of

the university, they define themselves as second-rate. To simplify the choice, an institution must develop more careful preselection or must experiment with teaching methods and approaches that would enable these students to master the abstract cognitive style. To preselect "more carefully" for conformist behavior would foreclose a continuing engagement of at least some students with some faculty members in a rewarding (and urgently needed) reassessment of the process of education and, indeed, of the discipline. It would also reduce the proportion of imaginative and reactive undergraduates in physics, with consequences for faculty morale and institutional status. We need to modify the environment to accommodate a wider diversity of students with a greater range of adaptive responses than in the past, or else we will be in a trap.

"Perhaps we're not teaching in the most efficient manner. These central ideas can be presented much more concisely; the problems could be somehow presented in a much more concise manner and leave more time for original work on the part of students."

"If I wanted to work at a problem and stop and think about it for a while, maybe even do some independent work on it, there just wasn't any opportunity to do this and I felt myself rebelling against the compartmentalized courses. There was very little thinking. I just don't bother doing the homework now. I approach the courses so I can get an A and in the easiest manner and it's amazing how little work you can do if you really don't like the course. This just isn't the right way to approach education, particularly when you're a senior."

The Departmental Environments

From the study of the movement of the students into and out of the various academic departments, I was struck with the way the departments functioned like a colony of living cells. Each department had its unique, semipermeable membrane which let in its own nutrients and filtered out its own "waste products." Thus, syllabus-free students tended to move out of a particular department and congregate in another which, at that time, was actively changing its curriculum and its image to be more attractive to the risk takers. The waste product of one cell often became the nutrient for its neighbor. The internal environment provided by each department was not uniform, since each was attracting a slightly different group of students and developing quite different "end products."

Some characteristics of the institutional environment clearly touched all of the departments, though not in equal measure. Some departments functioned like ecological niches, others as a kind of reservoir or supplier of students to several of the departments with rapid rates of growth. There were two departments that screened certain kinds of students out of the Institute entirely. The risk taker who found himself in one of these departments as a sophomore was more likely to experience a drop in grades, more likely to accept the department's definition of him as lacking intelligence or motivation and simply withdraw from the scene of battle. (Some of those students went on in related fields in other institutions to do very well indeed; some dropped out of higher education altogether and made little apparent use of their capability.)

A central task for an institution is to achieve a balance between openness and closure to stimuli: both the quality and quantity of stimuli (information techniques, etc.) to which the student must respond are obviously crucial to his education. A subtle, though somewhat less important, task for the student centers on his ability to remain open to new intellectual (and emotional) experiences while he is learning to neglect selectively certain parts of those experiences. In terms of the hidden curriculum some subjects, by virtue of their content and the way they are taught, require a high level of tolerance for ambiguity. Problems are open-ended, such as, How does a light bulb work? Assignments, in project laboratories especially, can be largely determined by the stu-

dents. This is in marked contrast to other subjects, where each student is required to schedule and organize his life in order to cover and memorize an extensive amount of material. The adaptive significance for the student of starting with his problem, his question, rather than someone else's, is profound. His investment in the outcome is real, not contrived.

One can locate the stresses in a university by the time at which they occur or by the geographical or social setting in which they seem to cluster. The point of the exercise is to build up a picture of the pressures in an institution so that one can begin to understand the adaptive patterns and the coping mechanisms required of individuals as they move through it. For example, from our interviews and from the data on the movement of students across course boundaries and from withdrawal and disqualification rates, we discovered that the seventh semester at M.I.T. appeared to present characteristic stresses that were qualitatively and quantitatively different from those occurring earlier. At another institution, at another time, the specifics would certainly vary, but the principle remains the same.

Issues of career commitment and the impending separation from the institution lead many students to reexamine in the first term of their senior year their identity, their sense of who they are and who they are about to become. The climate in which this self-questioning occurs is crucial. In many colleges students are asking such questions by the end of freshman year or early in sophomore year. The initial loneliness of freshmen, the career crisis for faculty at the age of 35 or at the point of tenure, are further examples of stresses that are linked in part to the individual's age, the distance he has traveled along his own developmental path. But they are also inextricably linked to the environment, to the opportunities for reflection or pressures to conform. The mastery of relativity theory, as noted earlier, presented a cognitive stress to students in sophomore physics in a setting where the grade was crucial. Whether they grasped the theory or were put down by it depended to a significant degree on the context in which they tried to learn it.

Must "Adjustment" Be Absolute?

Student responses to the dissonance between the formal curriculum and the hidden curriculum vary from romanticism through cynicism to helplessness. The student who becomes cynical zeroes in on the immediate means of survival and does little serious examination of long-term goals and consequences. He spends his energy on "psyching" the professor. The romantic holds to an idealized view of his education and of his professors, many of whom are also romantics. The romantic solution for the faculty member is piecemeal reform—the "experimental seminar." This is a temporarily more comfortable position but is not a sound basis for long-term planning, for significant educational reform, or for significant educational experimentation.

The student who has begun to feel helpless, unable to decipher successfully the messages confronting him, has the most serious and dangerous response. His self-esteem will drop, and he will have less energy available to think through his dilemma and alter his circumstances.

The life history of each of us, with its particular developmental progressions, is lived out in a social structure which has its own rate of change, its own shifts in values and relevance. The pressures and the related supports built into a culture or a college may significantly affect the choices that individuals make at significant branching points in their life histories. If the pressures are too great (or not great enough), if the support structure is ineffective, then the development of the individual can come to a standstill; the energy needed for growth becomes, instead, used up in maintaining a defensive position. Such individuals have a hard time changing. The society which has sustained such outcomes is the loser.

The first step in coming to understand a student's response to his educational environment may indeed be to ask about the degree of his adjustment to a specific stress. However, the student and the institution must at least speculate about the long-term consequences of that adjustment to the individual student and the reciprocal effect on the college of the student's having, at whatever cost, fitted in. In this period of rapid social and technological change, our survival a generation or two from now in some measure rests on our learning a great deal about the point at which an adjustment becomes irreversible, a cognitive style frozen.

Suggested Readings

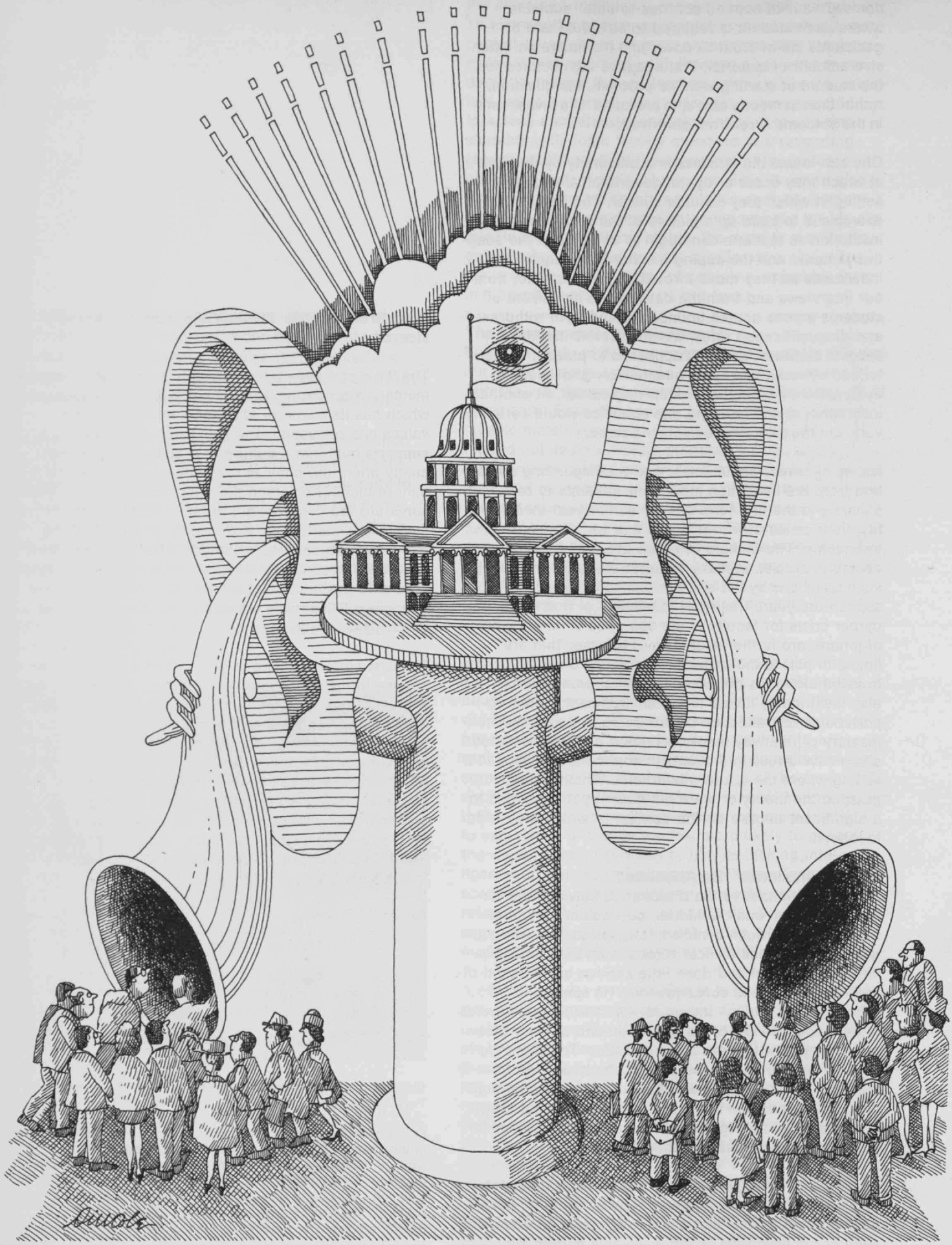
P. Heist (editor), *The Creative College Student: An Unmet Challenge.* San Francisco: Jossey-Bass, Inc., 1968.

Dr. Benson R. Snyder and Dr. M. J. Kahne, "Stress in Higher Education and Student Use of the University Psychiatrist," *American Journal of Orthopsychiatry,* January, 1969, pp. 23-35.

Dr. Benson R. Snyder, *The Hidden Curriculum.* New York: Alfred A. Knopf, Inc., forthcoming.

Sir Geoffrey Vickers, *Value Systems and Social Process.* New York: Basic Books, 1968.

Dr. Benson R. Snyder came to M.I.T. to be Psychiatrist-in-Chief in the Medical Department in 1959; he studied at Bard College, Columbia University, the University of Pennsylvania, and New York University, and he interned at the University of Chicago Clinics and was resident in psychiatry at Cincinnati General Hospital. This article is drawn from Chapter 6 of Dr. Snyder's book, The Hidden Curriculum, *to be published early in 1971 by Alfred A. Knopf, Inc.*



New methods of communication—which amount to a Communications Revolution—have made it easy for leaders to communicate to their constituencies but have comparatively weakened the voices of the people in reaching their governments. Scattered efforts are being made to redress the balance: this article and its sequel deal with the institutional changes and technological means to effect them.

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Citizen Feedback: The Need and the Response

Citizen feedback—citizens' response to government policies and programs—comes in many forms, most of which are taken for granted. The most obvious direct form is the vote—to elect officials and occasionally to decide public issues directly through a ballot referendum or perhaps in a New England-style town meeting. Another frequent direct form of citizen feedback is applause—that is, the general overall response which is forthcoming from the citizenry or from some part of it when a public official says or does something of which they approve. Then there are various other types of individual expression which are potentially more informative and which are considered in detail later. Finally, there is political organization, which is also discussed later.

Voting, applause, individual expression, and political organization are direct forms of citizen response to government; there are, in addition, a number of indirect forms of citizen feedback which are derived simply from what individuals do from day to day. The actions they take, the decisions they make, what they choose to learn, and how they innovate in their daily lives—these activities are all subject to certain government influences, constraints, and incentives; and, conversely, these activities often say something about public policies and programs—how well they are working, whether they are achieving their objectives, and what secondary effects may be occurring. Such activities, properly understood, can provide valuable information to government. In a broader sense, indirect citizen feedback includes a myriad of statistics and social indicators. Such information as this is better referred to as "societal feedback" rather than "citizen feedback," since the individual citizen is less consciously in direct control of this information.

The form and balance of citizen feedback in modern developed nations has been greatly affected by the development of television, radio, and newspaper wire services. This Communications Revolution has made dissemination of centralized information very easy; President Nixon's press conferences simultaneously reach millions of television viewers and radio listeners, and later are summarized for a similarly large audience by the daily and then the weekly press. But how does this immense audience reach the President? Can new systems of citizen feedback capitalizing on our new technologies, such as the time-shared remotely accessible computer, be used to help redress the imbalance in political communication?

If indeed this can be done, the Communications Revolution could come to have as great a significance as the Industrial Revolution. For just as the Industrial Revolution diminished the power of the economic elite that had been most concentrated under the Feudal System, so also should the Communications Revolution diminish the power of today's "knowledge elite"—the so-called Establishment. In other words, the Communications Revolution should yield a more even distribution of knowledge power, just as the ongoing Industrial Revolution has been yielding a more even distribution of economic power.

It is important to sense that the process of redistributing knowledge power has already begun. Not only has television stimulated social consciousness; the colleges and universities, bulging with children of an increasingly large economic middle class, are helping to create a "knowledge middle class," suspicious of the old knowledge elite, of the Establishment, which is of privileged experts in government, of paternalistic specialists who continue to look down on what they once knew as the "ignorant masses." This new knowledge middle class does indeed have something to say.

Votes, Prices, and Citizen Feedback

In order to understand the character of direct citizen feedback, first consider one particular issue which individuals generally feel is beyond their direct control—that is, prices. People do not generally see their own individual actions in buying or selling any particular item at the going price as in fact influencing that price. And it is true that if a market is competitive, no single buyer or seller can noticeably affect the market price. Yet each decision to buy or sell is, in a sense, a vote for a particular product at a particular price. If enough such votes are not forthcoming to clear the market, then the price should change.

The price mechanism may in fact seem to be a more efficient communicator than the ballot box, since voting occurs infrequently—every two or four years for many elective offices—while buying and selling goes on almost continuously. However, there are gross inequities in the distribution of income and thus in that particular voting power which can be applied through the price

mechanism. Also, the price mechanism is not automatically applied to important secondary effects of economic activity—for example, environmental pollution. Furthermore, there are the distortions of competitive pricing caused by monopolies.

The shortcomings of the price mechanism do not mean we should abandon it. In fact, we are only beginning to realize that some of our most severe public problems may best be dealt with by constructing information systems and incentive structures which use the self-adjusting mechanism of prices—by redistributing income through the negative income tax, by levying effluent charges against polluters, and by encouraging information flows which favor competition over monopoly.

Like the price mechanism, the voting process today has serious limitations as a citizen-feedback mechanism. Voting for elected officials at infrequent intervals simply does not fully satisfy the desires of many citizens to participate in public decision making. In fact, electoral democracy, while still necessary, is clearly not sufficient in the light of the present Communications Revolution.

In many political contests the voter is frustrated by sensing little difference between competing candidates. He may realize that elections still provide the best means for integrating his views on various issues which concern him and for providing representation on other issues which fall beyond his attention span. But he may vote for a presidential candidate who promises not to escalate a war only to see later that promise go unfulfilled. He sees elected officials more and more as the captives of massive, unresponsive bureaucracies. And he may have enough to say on a few high-priority matters so that he finds the election process far from sufficient.

What seems to be needed is an overall citizen-feedback system to provide a bridge between the price mechanism and the voting process, thus spanning an increasingly broad and turbulent information stream.

The Communications Revolution and Protest Demonstrations

Television has made the citizen considerably more aware and given him a sense—if perhaps distorted—of his whole environment; in a sense it is by far the most powerful element in the Communications Revolution. He sees in his own living room all the current affairs of the day—including the statements of public officials whom he helped to elect.

This kind of instant news has short-circuited some of the communication hierarchies of the past—particularly those of government bureaucracies and political parties. Yet, while there has been considerable speed-up of communication from the center of society out to the citizen, there has yet been little done to increase the speed of communications back in to the center from the citizen; he is still expected to "go through channels" with his inquiries, requests, complaints, suggestions, and opinions.

However, certain resourceful citizens who felt strongly about issues during the decade of the 1960's found a way to be heard—the mass demonstration. Unlike applause, which shows approval, the demonstrations of the 1960's tended to focus on strong disapproval—disapproval of such things as war, prejudice, poverty, housing conditions, university policies, environmental pollution, urban highways, various neighborhood conditions, police actions, and judicial decisions. Efforts to use the same mechanism to express approval of government policies—for example, the "Honor America" demonstrations on July 4, 1970—have been less successful in attracting participants and attention.

In the 1950's political analysts often complained of public apathy. However, around the beginning of the 1960's, Professor Murray Levin of Boston University and others proposed that public inaction was due more to feelings of alienation than to feelings of apathy. Later in the 1960's this alienation gave way in certain quarters to action in the form of protest, particularly with the development of the civil rights movement, and indeed the 1960's can be characterized by this transition from apathy to alienation to protest. By the fall of 1969, the Vietnam Moratorium demonstrations were well-coordinated, nationwide undertakings, many of whose participants belonged to a new generation which grew up in the 1950's and gained its new awareness of societal problems through television. These young people had been exposed to a dramatic speed-up in communications from the center out, and they completed the feedback loop when they learned to use the same medium—television—as a weapon (and I use the term "weapon" advisedly) for communication back to the center.

The change has been so complete that now—in 1970—complaints about public apathy are seldom heard. In fact, President Nixon now praises those who remain silent, claiming that they represent a majority who approve of his policies, and Vice-President Spiro Agnew has moved even more directly to discredit the mass-protest form of citizen feedback. As John S. Saloma III, Associate Professor of Political Science at M.I.T., noted in the *Boston Globe* early last year, President Nixon "is a shrewd enough student of 'the new politics' to know that its highly ad hoc organizational forms require communication via mass media to be more effective. [One element of] the Nixon-Agnew strategy is to break the de facto alliance between the nation's media and the protest movement." Indeed, the Vice-President

called on his audience at the 1970 midwinter Governors' Conference in Washington to lead a campaign "to drive these bizarre extremists from their preemptive positions on our television screens and on the front pages of our newspapers."

Street protests may not seem a desirable form of citizen feedback even to many who participate in them. But what other forms of feedback are available, in what many citizens now see as a crisis situation? Are other forms of citizen feedback—the telegram campaigns, petition drives, teach-outs, door-to-door canvasses used extensively during the Kent-Cambodia crisis of the spring of 1970—rapid and effective enough to keep pace with the present rate of change within our society and with the speed-up in communications from the center out?

Developing a comprehensive system for citizen feedback on government policies cannot exactly be viewed as searching for the modern equivalent of the New England open town meeting, unless one recognizes that rarely have all citizens participated in decisions on all issues at such town meetings. The private citizen suffers not only from limitations of perspective—as the specialist policy adviser does—and of knowledge—as the generalist elected representative does—but also from limitations of time and incentive if he is not paid or otherwise significantly rewarded for pondering societal problems. It is only because modern communications make it feasible for all citizens to have easy access to inexpensive receivers and transmitters of information that any citizens who in fact have a stake in, some experience on, or a deep concern about particular societal problems can then make real contributions to the solution of such problems.

The contribution of the individual citizen need not be a well-articulated opinion or suggestion. A personal complaint, or even a well directed inquiry by a citizen, can help trigger a change in government policy—if only government will listen.

Citizen-Feedback Innovations

A number of recent innovations, both inside and outside of government, may help government and other societal institutions listen to the citizen. Bills have recently been introduced at all levels of government in the United States calling for establishment of the ombudsman—a government official who investigates citizen complaints against government agencies. Much of the U.S. interest in this Swedish innovation of 1809 has been focused at the state level, since, as Ralph Nader has noted, "no other governmental unit pervades the lives of more citizens more regularly than does the state." However, the neighborhood city halls of New York City, Boston, and elsewhere—more accessible to those citizens who would rather state a complaint in person—are innovations at the local level with certain ombudsman-like qualities. Yet citizen feedback initiated at the neighborhood level must reach up the line to whatever level is responsible for setting regulations and procedures; otherwise, the same problems will occur again.

When I served for four years as one of 280 members of the Massachusetts legislature, I never doubted the ability of any legislator to get something done for a complaining constituent, but I did have serious doubts as to how often a *pattern* of complaints would be discovered among this group of 280 complaint receivers. Unfortunately, even when certain patterns of administrative abuses did become apparent, as in the case of license suspensions by the Registry of Motor Vehicles, long-run corrective action would sometimes be avoided by certain legislators who saw their success at the polls depending primarily on continued influence peddling on behalf of individual constituents with recurring complaints. One such legislator, during a legislative debate on an ombudsman bill which I filed in 1964, waved a wad of notes about errands he was running for constituents and said to me, "Do you think I get elected because of how I vote on legislation?"

The service function of legislators on behalf of individual constituents has become so important that it often overshadows or even works against the legislative function. One Massachusetts legislator once told me he was voting against the best interests of his legislative district on a particular bill because that particular vote would help him stay in the favor of a particular influence-peddler who was in a powerful position to do specific favors for that legislator's constituents.

Most ombudsman proposals call for periodic reporting on the part of the ombudsman to the legislative body, which makes sense for two reasons. First, certain administrative practices can best be improved through legislation. Secondly, it is generally felt that the legislature needs to improve its legislative oversight capability, particularly since the executive branch has become increasingly large and complex and since the legislature has delegated more and more rule-making powers to administrative and regulatory agencies.

The "neighborhood city hall," generally credited to New York's Mayor John Lindsay, is another innovation of the 1960's in pursuit of a more decentralized, more accessible complaint system. In the case of New York City, such "local city halls" are based primarily on IRMA, an Information and Referral Manual, a 3,000-card Rolodex file organized by topic areas such as animals, abandoned cars, etc., which records both public and private agencies that can provide rapid and satisfactory help. When a citizen brings a problem to one of New York's

neighborhood city halls, a paid government employee (volunteers were tried without much success) usually finds a solution in IRMA. But the neighborhood city hall also furnishes professional help and technical staff to community organizations upon request, and it is also a focus for "neighborhood interdepartmental cabinet" meetings of various governmental officials with responsibilities in the particular neighborhood. Better coordination of interrelated functions of separate agencies has resulted.

Outside of government, the most obvious place to look for citizen feedback systems is within the structure of political parties. A service-oriented feedback system did exist in this setting some years ago—it was the ward-heeler system.

While remnants of the ward-heeler system can still be found today, generally speaking, the ward-heeler is dead. His passing from the political scene has left a vacuum which ombudsmen and neighborhood city halls are attempting to fill. While U.S. political parties at this time appear to be fairly weak in responding to the challenge of the Communications Revolution, two new projects of the Republican National Committee do merit watching to see how well they develop.

First are the Republican Action Centers, being opened, primarily in Negro ghettos in large cities, as part of an Action Now Program. The first of these, the Action Center in Detroit, has handled at its peak an average of 100 phone calls per day on problems ranging from unemployment and abandoned families to burnt-out street lights and late social security checks. The systems for establishing and operating these centers are quite similar to the Boston and New York little city halls; the major difference lies in the Action Center's lack of power since, on the level where most of the problems must be solved, there is no major Republican figure. However, simply because they lack formal ties with the bureaucracy, the personnel of these centers are more inclined to become advocates of the citizen in dealings with government. And these Action Centers through skillful management of press releases do have the power of publicity, which in theory is the ultimate weapon possessed by most ombudsmen, who are also similarly buffered from the bureaucracy.

Another new Republican program is called Listening Posts, designed to provide in-depth information on important problems to Republican leaders at the state and national level. Local Republicans are asked by the Republican National Committee to gather together a representative group of citizens who have a common concern. The participants are not chosen for their friendliness to the Republican Party but instead for their likelihood of giving honest opinions and articulating problems. After each session a one-page summary is prepared for transmittal to Republican leaders in the state where the discussion took place. For each problem area discussed by various Listening Posts, a 30-minute presentation is prepared for national party leaders, including the President.

On the Democratic side, innovations such as Eugene McCarthy's house-to-house canvassing on issues and Robert Kennedy's "community action corps" are being developed further—not within the formal structure of the Democratic Party, however, since neither of these presidential candidates was nominated in 1970.

Modern communications media, which helped kill the ward-heeler by exposing and attacking his weaknesses, are themselves trying to help fill that vacuum. Letters-to-the-editor columns have now been supplemented in practically every major metropolitan daily newspaper by "action-line" columns which handle complaints mailed or phoned in by readers.

In addition, there is regular reporting of opinion polls, and sometimes such polls are specially commissioned by an individual newspaper which wants to report how people within its particular metropolitan area feel on current issues. Such polls usually select citizens at random, and so most of those asked may not have a direct stake in the issue at hand. Scientific sampling techniques would suggest that this is the best way to eliminate bias, but some measure of intensity of feeling is needed for effective citizen feedback.

A most obvious form of citizen feedback is now occupying a large part of the programming of many radio stations; I refer, of course, to the increasingly popular radio talk shows whose participants discuss a wide variety of issues.

Such participants therefore, being self selected, feel more intensely about the subjects they choose to dis-

cuss than do citizens interviewed in opinion polls. Educational television is now going one step further than most of the radio shows by seeking feedback based on a balanced knowledge of the arguments on all sides of an issue. "The Advocates," a new television show, has experimented with various mail, telephone, and button-pushing arrangements for viewers and members of the studio audience to cast their "vote" for or against whatever specific proposal is under discussion.

But no matter how much they come to report citizen feedback, the mass media will probably always be primarily oriented towards reporting societal feedback (what's happening, more than what people think) and feedforward (information projected both forward from the center of society to the citizens, and forward in time so as to suggest what consequences will likely occur if various choices are made by individual citizens and by the society as a whole).

Also, the media have to be highly selective. This is particularly apparent in the "action line" columns. A newspaper may print five to ten problems and their solutions every day, but it may receive 100 or more. Typically, those which are not published are not even answered by mail.

The Professions and Citizen-Feedback Design

That the need for grievance investigation, public discourse on problems, and formal articulation of issues and answers is urgent is demonstrated by the overload on the present system. Other forces besides the media, working to expose inadequacies in bureaucracies and in "the system" in general, are so deluged with inquiries, complaints, and suggestions that most go unanswered. This is true even of the thousands of letters received by the number one ombudsman in the United States today, Ralph Nader—a self-appointed individual who has no more than the power of the law and public opinion at his disposal. Mr. Nader's effectiveness suggests that the Communications Revolution may well be tipping the balance of power in favor of such individuals and against large organizations.

Indeed, Mr. Nader's seemingly unsystematic system is better characterized today as a movement, which bears the label "consumerism." Big corporations and big unions as well as big government are attacked by Ralph Nader and his youthful band of student interns for allowing health hazards, monopoly practices, deception, and the like, to persist.

In a recent interview on TV's "Face the Nation," Ralph Nader was asked why the scientific community had not joined with significant segments of the legal community and the mass media in this consumer movement. He replied that up until now the scientific community had seen its financial support coming from sources which, if anything, work against the interests of the consumer. In a sense, he was saying that almost the entire scientific community had been bought off. Until recently Nader had been saying the same thing about his own profession, but as *Time* has reported, of the 39 *Harvard Law Review* editors who graduated in June, 1970, "not one intends to join a high-paying Wall Street law firm. Instead most plan to enter neighborhood agencies or government service—and represent the individual against the institutions."

Will a similar transformation take place in the scientific community? While it takes a good lawyer to use hard facts to prove a point, more often than not it takes a good scientist to produce such facts and to produce the information systems needed. Should the scientist in fact become dedicated to the solution of societal problems, he will have to use care not to overplay his role. For the perspective of the scientific expert, when viewing society as a whole, is limited by his own role as a specialist. Yet science must somehow cut through the complexities of urgent societal issues and help articulate policy options about which citizen value judgments must be rendered.

A citizen-feedback system should not be viewed as simply feeding back opinions already formulated by citizens acting independently of the system. The word *feedback* implies a closed loop where citizens affect policies (and projections) which in turn affect citizens, etc. Scientists readily see themselves as having roles to play in open-loop planning, but they often fail to provide for continuous adjustment of plans in accordance with partial results and on the basis of opinions from persons directly affected by such plans.

A Sequence for Understanding

Here is a hypothetical sequence for the use of various components of a citizen-feedback system, selected to demonstrate the important role of scientists not only in producing feedforward but also in interpreting feedback.

First, feedback reports which enumerate complaints about government programs are used to identify problem situations before they reach crisis proportions. Governor Ferré of Puerto Rico characterizes his new citizen-feedback system of this sort as allowing "government by anticipation, rather than by crisis."

Once evidence of dissatisfaction with some particular government program has helped to identify a societal issue, other components of a citizen-feedback system are then employed—first to understand and then to help resolve that issue. For example, better understanding of an issue by both government officials and citizens can result from a relatively tight feedback loop between

specialists who present arguments about alternatives and generalists who express their preferences among alternatives. This might be done in discussion meetings, in participatory television or radio shows, by newspaper ballots, or generally by whatever interactive media might allow a rapid interplay of issue analysis and opinion formulation.

To speed opinion formulation, scientific analysis can to some degree be preprogrammed. For example, by using keyboard and display terminals attached to a time-shared computer, "votes" by interested citizens might be entered and the distribution of such votes among competing alternatives displayed. Then representatives of whatever diverse opinions arise can be asked to articulate their positions, following which the same, or somewhat reformulated, "votes" can be taken again.

Whether or not an issue which has been illuminated through such an iterative process can be resolved will depend upon whether differences of opinion are shown to stem from different degrees of education on the issue or from fundamental differences in values. "Voting" on issue alternatives in this way is not the only method by which preferences may be better understood, nor is statistical feedback the only way in which scientific analysis can be preprogrammed into a dynamic societal decision-making system. Preprogrammed mathematical decision models, which might also be remotely accessible in a time-shared computer, could be used in a citizen-feedback system to allow citizens in competing "interest groups" (ones revealed to have fundamentally different values or preferences) to "play" experimentally against each other and/or against absent interest groups in trying to determine what legislative, executive, or other action could best be taken to resolve a particular issue. Such "games" could even be designed to be fun as well as informative.

In all of these situations, the scientist clearly has an important role to play, a role which in the best sense falls in the field of public education. The current tide of anti-science feeling will only subside when, in this sense, science is used "for the people" and "by the people."

Toward the Study of Societal Systems

While science has this educational opportunity in the operation of a citizen-feedback system, technology is needed in the design of this and other societal systems. Yet there is today no well-developed academic discipline concerned in broad terms with the design and development of more rational societal systems.

Various branches of social science are concerned with the study of past and current societal systems—but seldom with the design of future ones. For example, although economics is involved with the price mechanism and political science with the voting process, neither is likely to be too concerned with the application of new communications technology to citizen feedback systems, even though such systems might supplement the price mechanism and the voting process.

It is true that there are several applied disciplines, including urban planning, public administration, business administration, management science, operations research, and industrial engineering, which are concerned with particular aspects of societal decision-making systems. Yet these disciplines focus on the design not of general societal systems but of subsystems, which are further constrained by the underlying assumptions of the bureaucratic-corporate-urban culture which they seek to describe.

What seems to be needed in our universities, particularly in our technological universities, is a new discipline, perhaps even a new school, of societal systems —systems for societal communication, decision making, and development—drawing upon or even integrating elements of social science and humanities (the latter because societal feedforward must in the best sense be both informative and entertaining); the system aspects of medicine, law, and education; planning, management and related interdisciplinary programs concerned with decision making (for example, computer sciences and operations research); and the problem-solving techniques of engineering (for example, civil engineering's concern with large-scale transportation and other public service systems and electrical engineering's concerns with the technology of the Communications Revolution).

Puerto Rico's Citizen-Feedback System

The first in a series of prototype citizen-feedback systems is now in operation in Puerto Rico, the result of a project conducted by John D. C. Little (who teaches marketing in M.I.T.'s Sloan School of Management and is Director of the Institute's Operations Research Center) along with myself and a number of former and present M.I.T. students, on the invitation of Governor Luis A. Ferre, an M.I.T. alumnus and a member of the M.I.T. Corporation. Funds for this and related projects in Puerto Rico came from the U.S. Department of Housing and Urban Development, the Puerto Rican government, and the Ford Foundation.

Puerto Rico's citizen-feedback system takes an overall view of the needs of the citizen to communicate with government with inquiries, requests, complaints, suggestions, opinions, and volunteering. The resulting information system is flexible and not dependent upon fixed facilities, as are neighborhood city hall systems, nor upon single personalities, as are ombudsman systems.

The principal components of the Puerto Rican system are: a group of nonpolitical, easily accessible, specially trained citizen aides whose job is to serve individual citizens in the system by handling letters, phone calls, personal visits; a public service handbook which gives details about whom a citizen approaches and how he proceeds on any of about 800 government programs; and a feedback reporting system which gives the Governor, his cabinet, and his aides summaries and examples of cases in a manner which may suggest improvements in various government services and programs.

The citizen aides were initially located in the Governor's office and in certain San Juan fire stations, but the system is now being expanded on an islandwide basis so that numerous feedback stations manned by citizen aides are being located in fire stations in heavily populated neighborhoods. An islandwide, 24-hour, toll-free phone system which connects every neighborhood fire station directly to citizen aides in the Governor's office is being installed. A mobile unit is being prepared for use in rural areas.

Further experiments are being undertaken to develop other possible components of the system such as a talent bank, information retrieval to supplement the handbook, a tickler file on open cases, an opinion feedback questionnaire, listening-post experiments to seek reasons behind opinions, and various feedback presentation techniques to be employed in the Governor's Information Room or PRIDE (Puerto Rican Information and Decision Environment) and in public media.

Towards More Rational Societal Systems

Two or three prototype citizen-feedback systems similar to Puerto Rico's are planned elsewhere for the near future. Each such system is to be predicated simply on the proposition that there exists a communications gap between people and the institutions which are supposed to serve them. In order to narrow that gap in any specific situation, existing feedback mechanisms must first be inventoried and evaluated; these differ among cultures, states, and metropolitan areas. The next step is to design an overall communications system which both improves upon existing components (laws, regulations, administrative procedures, application forms, reports, civil service attitudes, policy review techniques, etc.) and adds new components (hardware such as telephone networks, software such as decision models and computer programs, personnel such as citizen aides and ombudsmen, media such as interactive television, etc.).

The technology on which to base citizen-feedback systems is available—though rapidly changing. Hardware produced by the Communications Revolution generally becomes available much in advance of needed software and regulations, and this fact leads, of course, to a pessimistic view of the Communications Revolution which George Orwell in his *1984* portrays by the image of Big Brother controlling our lives. Big Brother could in fact be the result if the Communications Revolution changed only technology and not the culture which controls that technology.

However, the Communications Revolution seems to be creating a new culture, less elitist than the old, less dependent for communication on the hierarchical channels of bureaucracy, less susceptible to manipulation by corporate managers and paternalistic experts, less likely to be herded along in great urban masses. Big Brother is an extrapolation of the bureaucratic-corporate-urban culture which begot the Communications Revolution. Citizen feedback (or societal control by Little Brothers) is a concept more consistent with the participatory culture which seems in turn to have been begotten by the Communications Revolution. It might help turn the Communications Revolution into what Governor Ferré calls a "revolution in human understanding."

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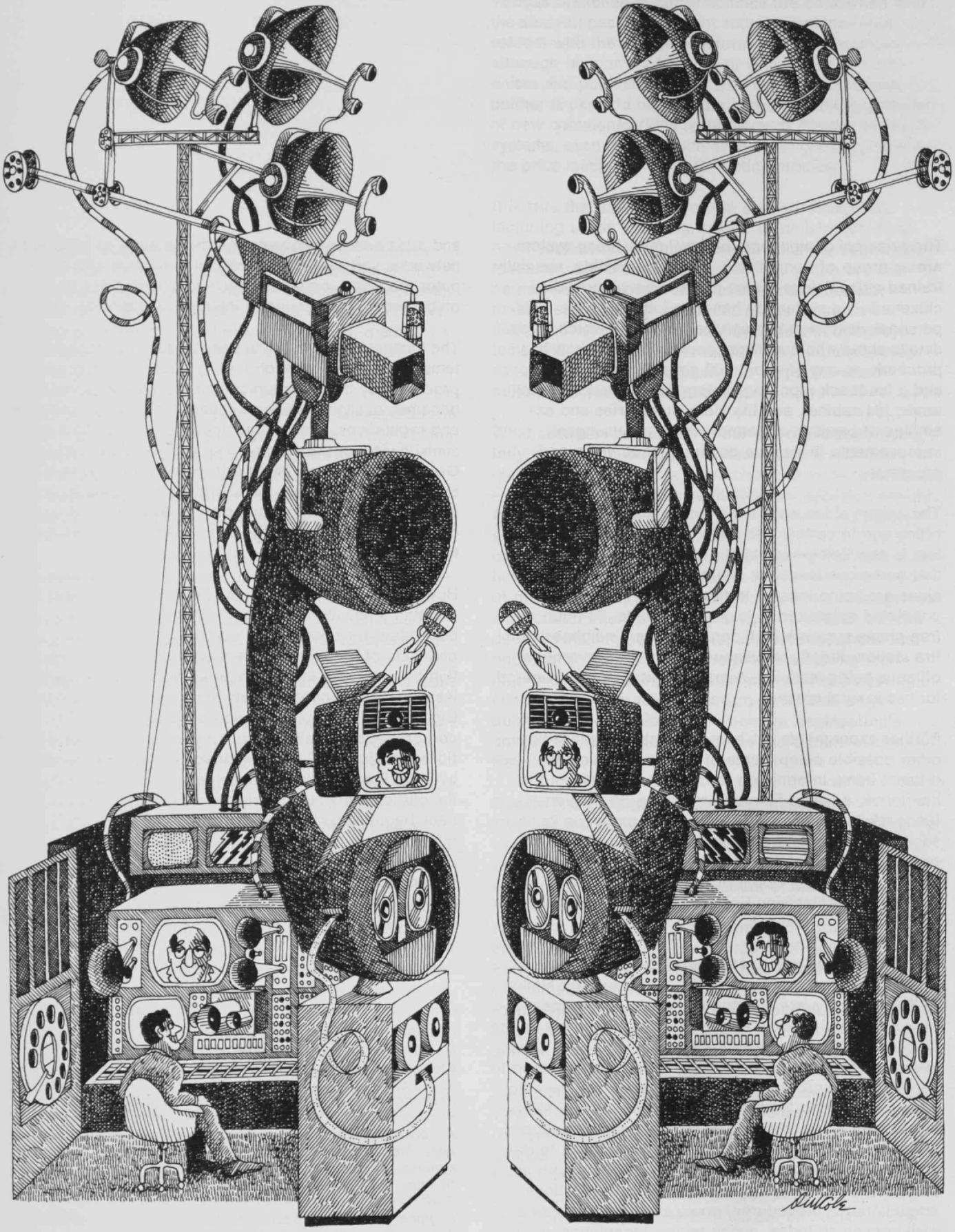

Technology can be used more effectively to help people communicate their values to each other and to come to consensus decisions. Here are some design principles for systems that could make the allocation of resources more democratic and ease those disturbances to society which other new technology has caused

Thomas B. Sheridan
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Citizen Feedback: New Technology for Social Choice

Usually the best way to discuss and resolve the choices that arise within groups of people is face-to-face and personally. For this reason, city planners and educators alike are calling for new kinds of communities for working, living, and learning, based more on familial relationships between people than on contractual relationships. When people get to know one another, conflicts have a way of being accommodated.

Beyond the circle of intimacy the problem of communication is obviously much greater; and while social issues can still be resolved more or less arbitrarily, it is more difficult to resolve them satisfactorily.

The "circle of intimacy" is constrained in its radius. One analyst has estimated that the average person in his lifetime can get to know, on a personal, face-to-face basis, only about 700 people—and surely one can know well only a much smaller number. The precise number is not important: the point is that it is dictated by the limitations of human behavior and is not greatly affected by urban population growth, by speed of transportation and communication, by affluence, or by any other technologically induced change in the human condition.

Indeed, these changes underlie the problem as we know it. Although the number of people with whom we have intimate face-to-face communication remains constant, we are in close proximity to more and more people.

We are, moreover, a great deal more dependent on one another than we used to be when American society was largely agrarian. We are all committed together in planning and paying for highways and welfare. We pollute each other's water and air. We share the risks and the costs of our military-industrial complex and the foreign policy which it serves. Technology, while aggravating the selfishly independent consumption of common resources, has made communications beyond the circle of intimacy both more awkward and more urgent.

Beyond the circle of intimacy, what kind of communications make sense? Surely most of us do not demand personal interactions with "all those other people." Yet in order to participate realistically in the decisions of industry and commerce, and in government programs to aid and regulate the processes which affect us intimately, we as citizens need to communicate with and understand the whole cross-section of other citizens.

Does technology help us in this? Can it help us do it better? We may now dial on the telephone practically anywhere in the world, to hear and be heard with relatively high fidelity and convenience. We may watch on our television sets news as it breaks around the world and observe our President as though he were in our living room. We can communicate individually with great flexibility; and at our own convenience we can be spectators en masse to important events.

But effective governance in a democracy requires more than this. It requires that citizens, in various ways and with respect to various public issues, can make their preferences known quickly and conveniently to those in power. We now have available two obvious channels for such "citizen feedback." First, we go to the polls roughly once a year and vote for a slate of candidates; second, we write letters to our elected representatives.

There are other channels (see Chandler Stevens' preceding article in this issue) by which we make our feelings known, of course—by purchasing power, by protest, etc. But the average citizen wields relatively little influence on his government in these latter ways. In terms of effective information transmitted per unit time, none of the presently available channels of citizen feedback rivals the flow from the centers of power outward to the citizens via television and the press.

What is it that stands in the way of using technology for greater public participation in the important compromise decisions of government, such as whether we build a certain weapon, or an S.S.T., or what taxes we should pay to fund what federal program, or where the law should draw the line which may limit one person's freedom in order to maintain that of others?

Somehow in an earlier day decisions were simpler and could involve fewer people—especially when it came to the use of technology. If the problem was to span a river and if materials and the skills were available, you went ahead and built the bridge. It would be good for everyone.Thus with other blessings of technology. There seemed little question that higher capacity machines of production or more sophisticated weapons were inherently better. There seemed to be an infinite supply of air, water, land, minerals, and energy. Today, by contrast, every modern government policy decision is in effect a compromise—and the advantages and dis-

advantages have to be weighed not only in terms of their benefits and costs for the present clientele, but also for future generations. We are interdependent not only in space but in time.

Such complex resource allocation and benefit-cost problems have been attacked by the whole gamut of mathematical and simulation tools of operations research. But these "objective" techniques ultimately depend upon subjective value criteria—which are valid only so far as there are effective communication procedures by which people can specify their values in useful form.

How can the citizen be more effectively a party to large-scale policy decision? Can current and future technology serve to improve the feedback communication link?

The "Social Choice" Problem

The long-run prospects are bright, I think, that new technology can play a major role in bringing the citizenry together, individually or in small groups, communicating and participating in decisions, not only to help the decision makers but also for the purpose of educating themselves and each other. Hardware in itself is not the principal hurdle. No new breakthroughs are required. What is needed, rather, is a concerted effort in applying present technology to a very classical problem of economics and politics called "social choice"—the problem of how two or more people can communicate, compare values or preferences on a common scale, and come to a common judgment or preference ordering.

The central question is, How can we establish scales of value which are mutually commensurable among different people? Many of the ancient philosophers wrote about this problem. The Englishmen Jeremy Bentham and John Stuart Mill first developed the idea of "utility" as a yardstick which could compare different kinds of things and events for the *same person.* More recently the American mathematician Von Neumann added the idea that not only is the worth of an event proportional to its utility, but that of an anticipated event is proportional also to the probability that it will happen. This simple idea created a giant step in mathematically evaluating combinations of events with differing utilities and differing probabilities—but again for a single person.

The recent history of comparing values for *different people* has been a discouraging one—primarily because of a landmark contribution by economist Kenneth Arrow. He showed that, if you know how each of a set of individuals orders his preferences among alternatives, there is no procedure which is fair and will always work by which, from this data, the group as a whole may order its preferences (i.e. determine a "social choice"). In essence he made four seemingly fair and reasonable assumptions: the social ordering of preferences is to be based on the individual orderings; there is no "dictator" whom everyone imitates; if every individual prefers alternative A to alternative B, the society will also prefer A to B; and, finally, if A and B are on the list of alternatives to be ordered, it is irrelevant how people feel about some alternative C, which is not on the list, relative to A and B. Starting from these assumptions, he showed (mathematically) that there is no single consistent procedure for ordering alternatives for the group which will always satisfy the assumptions.

A number of other theoreticians in the area have challenged Arrow's theorem in various ways, particularly through challenging the "independence of irrelevant alternatives" assumption. The point here is that things are never evaluated in a vacuum but clearly are evaluated in the context of circumstance. A further charge is a pragmatic one: while Arrow proves inconsistencies *can* occur, in the great majority of cases likely to be encountered in the real world they would not occur, and if they did they probably would be of minor significance.

There are many other complicating factors in social choice, most of which have not been, and perhaps cannot be, dealt with in the systematic manner of Arrow's "impossibility theorem." For example, there is the very fundamental question of whether the individual parties involved in a group choice exercise will communicate their true feelings and indicate their uncertainties, or whether they will falsify their feelings so as to gain the best advantage for themselves.

Further difficulties arise when we try to include in the treatment the effects of differences among the participants along the lines of intensity-of-feelings vs. apathy, or knowledge vs. ignorance, or "extended-sympathy" vs. selfishness, or partial vs. complete truthfulness; yet these are just the features of the social choice problem as we find it in practice.

To take as an ultimate goal the precise statement of social welfare in mathematical terms is, of course, nonsense. The differing experiences of individuals (and consequently differing assumptions) ensure that commensurability of values will never be complete. But this difficulty by no means relieves us of the obligation to seek value-commensurability and to see how far we can go in the quantitative assessment of utility. By making our values more explicit to one another we also make them more explicit to ourselves.

The Potential Contributions of Electronics

Electronic media notwithstanding, none of the newer means of communication yet does what a direct face-to-face group meeting (town meeting, class, bull session) does—that is, permit each participant to observe the feelings of the other participants—the smiles and frowns and gestures, the verbal expressions of approval or disapproval, or the apathetic silence—which may accompany any proposal or statement. As a group meeting gets larger, observation of how others feel becomes more and more difficult; and no generally available technology helps much. Telephone conference calls, for example, while permitting a number of people to speak and be heard by all, are painfully awkward and slow and permit no observation of others' reaction to any given speaker. The new Picture-Phone will eventually permit the participants in a teleconference to see one another; but experiments with an automatic system which switches everyone's screen to the person who is talking reveals that this is precisely what is not

wanted—teleconferees would like most to observe the facial expressions of the various conferees who are *not* talking!

It is when we consider the electronic digital computer that the major contributions of technology to social choice and citizen feedback are foreseen. Given the computer, with a relatively simple independent data channel to each participant, one can collect individual responses from all participants and show anyone the important features of the aggregate—and do this, for practical purposes, instantaneously.

All basic technology for such a system exists today. What is needed is thoughtful design—with emphasis on how the machine and the people interact: the way questions are posed to the group participants; the design of response languages which are flexible enough so that each participant can "say" (encode) his reaction to a given question in that language, yet simple enough for the computer to read and analyze; and the design of displays which show the "interesting features" or "pertinent statistics" of the response data aggregate.

This task will require an admixture of experimental psychology and systems engineering. It will be highly empirical, in the same way that the related field of computer-aided learning is highly empirical.

One can imagine a computer-aided feedback-and-participation system taking a variety of forms. For example:

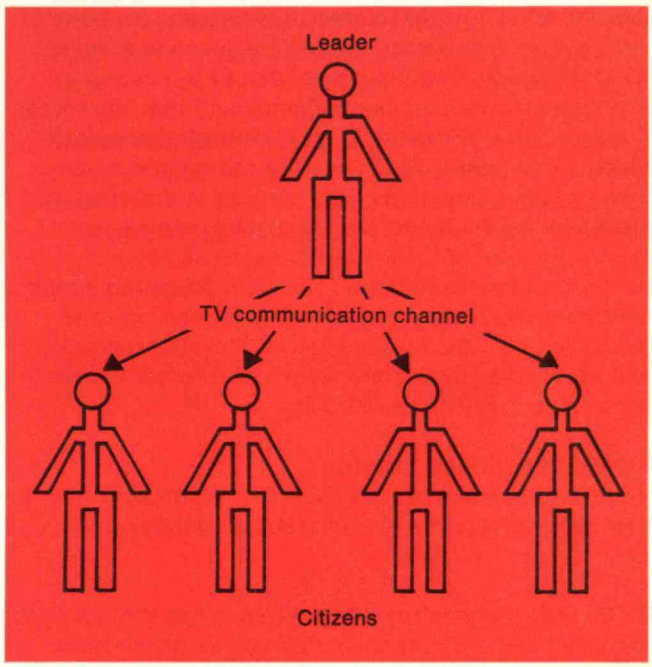
◇ A radio talk show or a television "issue" program may wish to enhance its audience participation by listener or viewer votes, collected from each participant and fed to a computer. Voters may be in the studio with electronic voting boxes or at home where they render their vote by calling a special telephone number. The "Advocates" program has demonstrated both.

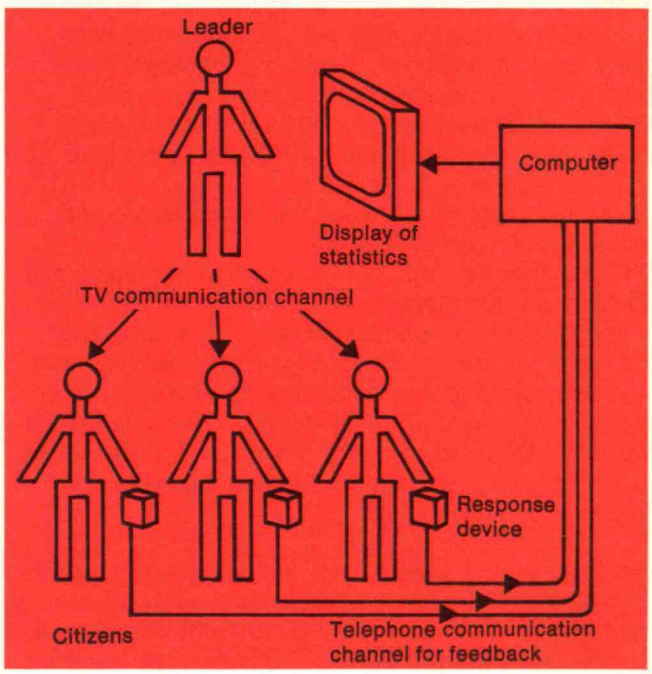
◇ Public hearings or town meetings may wish to find out how the citizenry feel about proposed new legislation—who have intense feelings, who are apathetic, who are educated to the facts and who are ignorant—and correlate these responses with each other and with demographic data which participants may be asked to volunteer. Such a meeting could be held in the town assembly hall, with a simple pushbutton console wired to each seat.

◇ Several P.T.A.'s, or alternatively several eighth grades, in the town may wish to sponsor a feedback meeting on sex education, drugs, or some other subject where truthfulness is highly in order but anonymity may be desired. Classrooms at several different schools could be tied together by rented "dedicated" telephone lines for the duration of the session.

◇ A duly elected representative in the local, state or national government could ask his constituency questions and receive their responses. This could be done through radio or television or alternatively could utilize a special van, equipped with a loudspeaker system, a rear-lighted projection/display device, and a number of

"In terms of effective information transmitted per unit time, none of the presently available channels of citizen feedback rivals the flow from the centers of power outward to the citizens via television and the press. . . . What is it that stands in the way of using technology for greater public participation in the important compromise decisions of government. . . ?"





chairs or benches which could be set up rapidly at street corners prewired with voter-response boxes and a small computer.

This last brings up one very important aspect of such citizen feedback or response-aggregation systems: that is that they can *educate* and *involve* the participants without the necessity that the responses formally determine a decision. Indeed, the teaching-learning function may be the most important. It demands careful attention to how questions are posed and presented, what operations are performed by the computer on the aggregated votes and what operations are left out, how the results are displayed, and what opportunity there is for further voting and recycling on the same and related questions.

Some skeptics feel that further technocratic invasion of participatory democracy should be prevented rather than facilitated—that the whole idea of the "computerized referendum" is anathema, and that the forces of repression will eventually gain control of any such system. They could be correct, for the system clearly presupposes competence and fairness in phrasing the questions and designing the alternative responses.

But my own fear is different. It is that, propelled by the increasing availability of glamorous technology and spurred on by hardware hucksters and panacea pushers, the community will be caught with its pilot experiments incomplete or never done.

A Group Feedback Session

Seven formal steps are involved in a technologically aided interchange of views on a social-choice question:

1) The leader states the problem, specifies the question, and describes the response alternatives from which respondents are to choose.
2) The leader (or automated components of the system) explains what respondents must do in order to communicate their responses (including, perhaps, their degree of understanding of the question, strength of feeling, and subjective assessment of probabilities).
3) The respondents set into their voting boxes their coded responses.
4) The computer interrogates the voting boxes and aggregates the response data.
5) Preselected features of this response-aggregate are displayed to all parties.
6) The leader or respondents may request display of additional features of the response aggregate, or may volunteer corrections or additional information.
7) Based upon an *a priori* program, on previous results and/or on requests from respondents, the leader poses a new problem or question, restarting the cycle from Step 1.

The first step is easily the most important—and also the most difficult. Clearly the participant must understand at the outset something of the background to any specific question he is asked, he must understand the question itself in nonambiguous terms, and he must understand the meaning of the answers or response alternatives he is offered. This step is essentially the same as is faced by the designer of any multiple-choice test or poll, except that there is the possibility that a much richer language of response can be made available than is usually the case in machine-graded tests. Allowed responses may include not only the selection of an alternative answer, but also an indication of intensity of feeling, estimates of the relative probability or importance of some event in comparison with a standard, specification of numbers (e.g. allowable cost) over a large range, and simple expressions of approval ("yea!") or disapproval ("boo!").

The leader may have to explain certain subtleties of voting, such as whether participants will be assumed to be voting altruistically (what I think is best for everyone) or selfishly (what I think is best for me alone, me and my family, etc.). Further, he may wish respondents to play roles other than themselves (If you were a person under certain specified circumstances, how would you vote?).

He may also wish to correlate the answers with informedness. He may do this by requesting those who do not know the answer to some test question to refrain from voting, or he can pose the knowledge test question before or after the issue question and let the computer make the correlation for him.

Insuring that participants "play fair," own up to their uncertainties, vote as they really feel, vote altruistically if asked, and so on, is extremely difficult. Some may always regard their participation in such social interaction as an advocacy game, where the purpose is to "win for their side."

Making Electronics Truly Responsive

The next two steps raise the question of what equipment the citizen will have for communicating his responses. At the extreme of simplicity a single on-off switch generates a response code which is easily interpreted by the computer, but limiting to the user. At the other extreme, if responses were to consist of natural English sentences typed on a conventional teletypewriter—which would certainly allow great flexibility and variety in response—the computer would have no basis for aggregating and analyzing responses on a commensurate basis (other than such procedures as counting key words). Clearly something in between is called for; for example, a voting box might consist of ten on-off switches to use in various combinations, plus one to indicate "ready," plus one "intensity" knob.

An unresolved question concerns how complex a single question can be. If the question is too simple, the responses will not be worth collecting and will provide little useful feedback. If too complex, encoding the responses will be too difficult. The ten switches of the voting box suggested above would have the potential (considering all combinations of on and off) for $2^{10} = 1024$ alternatives, but that is clearly too many for the useful answers to any one question. One could, however, ask a question with ten two-alternative parts, or five parts with four alternatives each, and so on.

It is probably a good idea, for most questions, to have some response categories to indicate "don't know" or

"don't understand the question," two quite different responses. If a respondent is being pressured by a time constraint, which may be a practical necessity to keep the process functioning smoothly, he may want to be able to say, "I don't have time to reach a decision"; this could easily be indicated if he simply fails to set the "done" switch. Some arrangement for "I object to the questions and therefore won't answer" would also be useful as a guide to subsequent operations.

The fourth step, in which the computer samples the voting boxes and stores the data, is straightforward as regards tallying the number of votes in each category and computing simple statistics. But extracting meaning from the data requires that someone should have laid down criteria for what is interesting; this might be done either prior to or during the session by a trained analyst.

It is at this point that certain perils of citizen feedback systems arise, for the analyst could (either unwittingly or deliberately) distort the interpretation of the voting data by the criteria he selects for computer analysis and display. Though there has been much research on voting behavior and on methods of analyzing voting statistics, instantaneous feedback and recycling poses many new research challenges.

That each man's vote is equally important on each question is a bit of lore that both political scientists and politicians have long since discounted—at least in the sense that voters naturally feel more intensely about some issues than about others. One would, therefore, like to permit voters to weight their votes according to the intensity of their feeling. Can fair means be provided?

There are at least two methods. One long-respected procedure in government is bargaining for votes—"I'll vote with you on this issue if you vote with me on that one." But in the citizen-feedback context, negotiating such bargains does not look easy. A second procedure would be to allocate to each voter, over a set of questions, a fixed number of influence points, say 100; he would indicate the number of points he wished the computer to assign to his vote on each question, until he had used up his quota of 100 points, after which the computer would not accept his vote. (Otherwise, were votes simply weighted by an unconstrained "intensity of feeling" knob, a voter would be rather likely to set the "intensity of feeling" to maximum and leave it there.)

Step five, the display of significant features of the voting data, poses interesting challenges concerning how to convey distributional or statistical ideas to an unsophisticated participant, quickly and unambiguously.

The sixth step would provide an opportunity for nonplanned feedback—informal exposition, challenges to the question, challenges to each other's votes, and verbal rebuttal—in other words a chance to break free of the formal constraints for a short time. This would be a time when participants could seek to influence the future behavior of the leader—the questions he will ask, the response alternatives he will include, and the way he manages the session.

A Simple Experiment

An experimental system embodying the features described above is in the earliest stages of evolution. Its respondents sit before small hand-held consoles, each with ten on-off switches, a continuous "adjust" knob and a "done" switch. Fourteen such consoles are connected by wire to a PDP-8 computer. The computer, routinely programmed to print a table of switch and knob positions after each question, can also be programmed to give simple statistics, graph distributions and correlations. At present, the leader simply makes his presentations (Steps 1 and 2) at a blackboard.

After initial experiments with student groups using a variety of topics, other groups of citizens or professionals will be brought into the research. At the next stage some of the participants will be "remoted" over closed-circuit television with no opportunity to talk back except through the consoles. At a further stage the equipment can be made portable. We hope that, in this way, the experiment can evolve continuously, benefiting from trial and error with respect to both procedures and hardware and gradually pointing the way for practical systems to enhance social choice in the larger community.

Suggested Reading

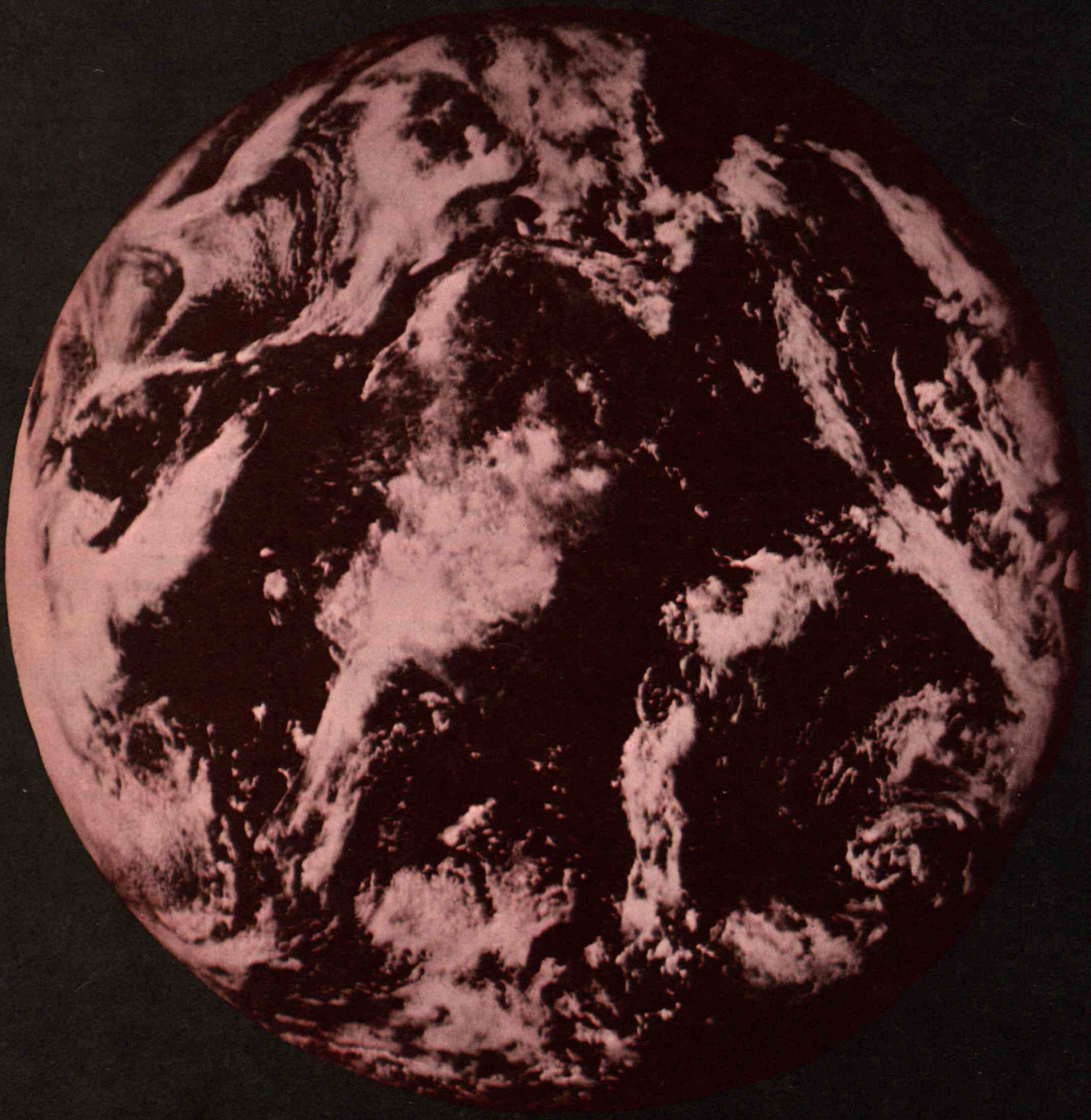
Sidney Hook, Editor, *Human Values and Economic Policy, A Symposium,* New York University Press, 1967.

Thomas B. Sheridan obtained an interdepartmental doctorate from M.I.T. (Sc.D., 1959) which included a year in psychology at Harvard. Since then he has been on the faculty of the Mechanical Engineering Department, where at present he heads the Systems and Design Division—his own special interest being "man-machine systems." As an avocation he chairs the faculty-student Committee on Discipline. He recently began a course in the Department of Humanities on "Technology, Values and Social Choice," which interest motivated this article.

"Within the next century, man may be facing choices from a four-pronged dilemma – suppression of modern industrial society by a natural resource shortage, collapse of world population from changes wrought by pollution, population limitation by food shortage, or population control by war, disease, and social stresses caused by physical and psychological crowding. . . .

"I suggest that the next frontier for human endeavor is to pioneer a better understanding of the nature of our social systems. The means are visible.

"What we do today fundamentally affects our future two or three decades hence. If we follow intuition, the trends of the past will continue into deepening difficulty. If we set up research and educational programs, which are now possible but which have not yet been developed, we can expect a far sounder basis for action."



System dynamics has demonstrated how companies and how urban systems behave in ways that run against most of what man would do to correct their ills. Now the same obtuse behavior can be assigned to the largest social issues which confront the nation and the world

Jay W. Forrester*
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Counterintuitive Behavior of Social Systems

This paper addresses several issues of broad concern in the United States: population trends; the quality of urban life; national policy for urban growth; and the unexpected, ineffective, or detrimental results often generated by government programs in these areas.

The nation exhibits a growing sense of futility as it repeatedly attacks deficiencies in our social system while the symptoms continue to worsen. Legislation is debated and passed with great promise and hope. But many programs prove to be ineffective. Results often seem unrelated to those expected when the programs were planned. At times programs cause exactly the reverse of desired results.

It is now possible to explain how such contrary results can happen. There are fundamental reasons why people misjudge the behavior of social systems. There are orderly processes at work in the creation of human judgment and intuition that frequently lead people to wrong decisions when faced with complex and highly interacting systems. Until we come to a much better understanding of social systems, we should expect that attempts to develop corrective programs will continue to disappoint us.

The purpose of this paper is to leave with its readers a sense of caution about continuing to depend on the same past approaches that have led to our present feeling of frustration and to suggest an approach which can eventually lead to a better understanding of our social systems and thereby to more effective policies for guiding the future.

A New Approach to Social Systems

It is my basic theme that the human mind is not adapted to interpreting how social systems behave. Our social systems belong to the class called multi-loop nonlinear feedback systems. In the long history of evolution it has not been necessary for man to understand these systems until very recent historical times. Evolutionary processes have not given us the mental skill needed to properly interpret the dynamic behavior of the systems of which we have now become a part.

In addition, the social sciences have fallen into some mistaken "scientific" practices which compound man's natural shortcomings. Computers are often being used for what the computer does poorly and the human mind does well. At the same time the human mind is being used for what the human mind does poorly and the computer does well. Even worse, impossible tasks are attempted while achievable and important goals are ignored.

Until recently there has been no way to estimate the behavior of social systems except by contemplation, discussion, argument, and guesswork. To point a way out of our present dilemma about social systems, I will sketch an approach that combines the strength of the human mind and the strength of today's computers. The approach is an outgrowth of developments over the last 40 years, in which much of the research has been at the Massachusetts Institute of Technology. The concepts of feedback system behavior apply sweepingly from physical systems through social systems. The ideas were first developed and applied to engineering systems. They have now reached practical usefulness in major aspects of our social systems.

I am speaking of what has come to be called industrial dynamics. The name is a misnomer because the methods apply to complex systems regardless of the field in which they are located. A more appropriate name would be *system dynamics.* In our own work, applications have been made to corporate policy, to the dynamics of diabetes as a medical system, to the growth and stagnation of an urban area, and most recently to world dynamics representing the interactions of population, pollution, industrialization, natural resources, and food. System dynamics, as an extension of the earlier design of physical systems, has been under development at M.I.T. since 1956. The approach is easy to understand but difficult to practice. Few people have a high level of skill; but preliminary work is developing all over the world. Some European countries and especially Japan have begun centers of education and research.

Computer Models of Social Systems

People would never attempt to send a space ship to the moon without first testing the equipment by constructing prototype models and by computer simulation of the anticipated space trajectories. No company would put

a new kind of household appliance or electronic computer into production without first making laboratory tests. Such models and laboratory tests do not guarantee against failure, but they do identify many weaknesses which can then be corrected before they cause full-scale disasters.

Our social systems are far more complex and harder to understand than our technological systems. Why, then, do we not use the same approach of making models of social systems and conducting laboratory experiments on those models before we try new laws and government programs in real life? The answer is often stated that our knowledge of social systems is insufficient for constructing useful models. But what justification can there be for the apparent assumption that we do not know enough to construct models but believe we do know enough to directly design new social systems by passing laws and starting new social programs? I am suggesting that we now do know enough to make useful models of social systems. Conversely, we do not know enough to design the most effective social systems directly without first going through a model-building experimental phase. But I am confident, and substantial supporting evidence is beginning to accumulate, that the proper use of models of social systems can lead to far better systems, laws, and programs.

It is now possible to construct in the laboratory realistic models of social systems. Such models are simplifications of the actual social system but can be far more comprehensive than the mental models that we otherwise use as the basis for debating governmental action.

Before going further, I should emphasize that there is nothing new in the use of models to represent social systems. Each of us uses models constantly. Every person in his private life and in his business life instinctively uses models for decision making. The mental image of the world around you which you carry in your head is a model. One does not have a city or a government or a country in his head. He has only selected concepts and relationships which he uses to represent the real system. A mental image is a model. All of our decisions are taken on the basis of models. All of our laws are passed on the basis of models. All executive actions are taken on the basis of models. The question is not to use or ignore models. The question is only a choice among alternative models.

The mental model is fuzzy. It is incomplete. It is imprecisely stated. Furthermore, within one individual, a mental model changes with time and even during the flow of a single conversation. The human mind assembles a few relationships to fit the context of a discussion. As the subject shifts so does the model. When only a single topic is being discussed, each participant in a conversation employs a different mental model to interpret the subject. Fundamental assumptions differ but are never brought into the open. Goals are different and are left unstated. It is little wonder that compromise takes so long. And it is not surprising that consensus leads to laws and programs that fail in their objectives or produce new difficulties greater than those that have been relieved.

For these reasons we stress the importance of being explicit about assumptions and interrelating them in a computer model. Any concept or assumption that can be clearly described in words can be incorporated in a computer model. When done, the ideas become clear. Assumptions are exposed so they may be discussed and debated.

But the most important difference between the properly conceived computer model and the mental model is in the ability to determine the dynamic consequences when the assumptions within the model interact with one another. The human mind is not adapted to sensing correctly the consequences of a mental model. The mental model may be correct in structure and assumptions but, even so, the human mind—either individually or as a group consensus—is most apt to draw the wrong conclusions. There is no doubt about the digital computer routinely and accurately tracing through the sequences of actions that result from following the statements of behavior for individual points in the model system. This inability of the human mind to use its own mental models is clearly shown when a computer model is constructed to reproduce the assumptions held by a single person. In other words, the model is refined until it is fully agreeable in all its assumptions to the perceptions and ideas of a particular person. Then, it usually happens that the system that has been described does not act the way the person anticipated. Usually there is an internal contradiction in mental models between the assumed structure and the assumed future consequences. Ordinarily the assumptions about structure and internal motivations are more nearly correct than are the assumptions about the implied behavior.

The kind of computer models that I am discussing are strikingly similar to mental models. They are derived from the same sources. They may be discussed in the same terms. But computer models differ from mental models in important ways. The computer models are stated explicitly. The "mathematical" notation that is used for describing the model is unambiguous. It is a language that is clearer, simpler, and more precise than such spoken languages as English or French. Its advantage is in the clarity of meaning and the simplicity of the language syntax. The language of a computer model can be understood by almost anyone, regardless of educational background. Furthermore, any concept and relationship that can be clearly stated in ordinary language can be translated into computer model language.

There are many approaches to computer models. Some are naive. Some are conceptually and structurally inconsistent with the nature of actual systems. Some are based on methodologies for obtaining input data that commit the models to omitting major concepts and relationships in the psychological and human reaction areas that we all know to be crucial. With so much activity in computer models and with the same terminology having different meanings in the different approaches, the situation must be confusing to the casual observer. The key to success is not in having a computer; the important thing is how the computer is used. With respect to models, the key is not to computerize a model, but

instead to have a model structure and relationships which properly represent the system that is being considered.

I am speaking here of a kind of computer model that is very different from the models that are now most common in the social sciences. Such a computer model is not derived statistically from time-series data. Instead, the kind of computer model I am discussing is a statement of system structure. It contains the assumptions being made about the system. The model is only as good as the expertise which lies behind its formulation. Great and correct theories in physics or in economics are few and far between. A great computer model is distinguished from a poor one by the degree to which it captures more of the essence of the social system that it presumes to represent. Many mathematical models are limited because they are formulated by techniques and according to a conceptual structure that will not accept the multiple-feedback-loop and nonlinear nature of real systems. Other models are defective because of lack of knowledge or deficiencies of perception on the part of the persons who have formulated them.

But a recently developed kind of computer modeling is now beginning to show the characteristics of behavior of actual systems. These models explain why we are having the present difficulties with our actual social systems and furthermore explain why so many efforts to improve social systems have failed. In spite of their shortcomings, models can now be constructed that are far superior to the intuitive models in our heads on which we are now basing national social programs.

This approach to the dynamics of social systems differs in two important ways from common practice in social sciences and government. There seems to be a common attitude that the major difficulty is shortage of information and data. Once data is collected, people then feel confident in interpreting the implications. I differ on both of these attitudes. The problem is not shortage of data but rather our inability to perceive the consequences of the information we already possess. The system dynamics approach starts with the concepts and information on which people are already acting. Generally these are sufficient. The available perceptions are then assembled in a computer model which can show the consequences of the well-known and properly perceived parts of the system. Generally, the consequences are unexpected.

Counterintuitive Nature of Social Systems

Our first insights into complex social systems came from our corporate work. Time after time we have gone into a corporation which is having severe and well-known difficulties. The difficulties can be major and obvious such as a falling market share, low profitability, or instability of employment. Such difficulties are known throughout the company and by anyone outside who reads the management press. One can enter such a company and discuss with people in key decision points what they are doing to solve the problem. Generally speaking we find that people perceive correctly their immediate environment. They know what they are trying to accomplish. They know the crises which will force certain actions. They are sensitive to the power structure of the organization, to traditions, and to their own personal goals and welfare. In general, when circumstances are conducive to frank disclosure, people can state what they are doing and can give rational reasons for their actions. In a troubled company, people are usually trying in good conscience and to the best of their abilities to solve the major difficulties. Policies are being followed at the various points in the organization on the presumption that they will alleviate the difficulties. One can combine these policies into a computer model to show the consequences of how the policies interact with one another. In many instances it then emerges that the known policies describe a system which actually causes the troubles. In other words, the known and intended practices of the organization are fully sufficient to create the difficulty, regardless of what happens outside the company or in the marketplace. In fact, a downward spiral develops in which the presumed solution makes the difficulty worse and thereby causes redoubling of the presumed solution.

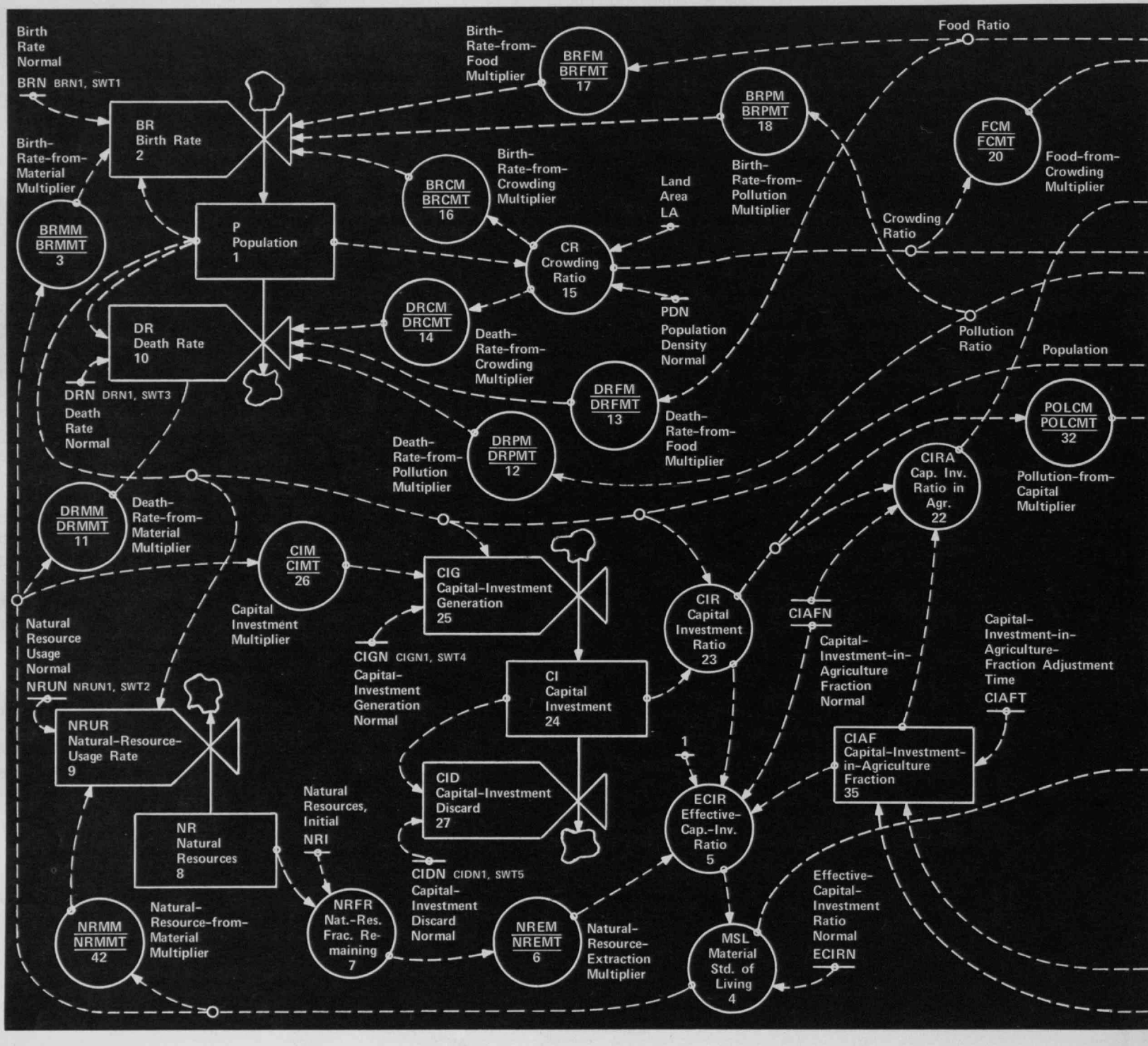
The same downward spiral frequently develops in government. Judgment and debate lead to a program that appears to be sound. Commitment increases to the apparent solution. If the presumed solution actually makes matters worse, the process by which this happens is not evident. So, when the troubles increase, the efforts are intensified that are actually worsening the problem.

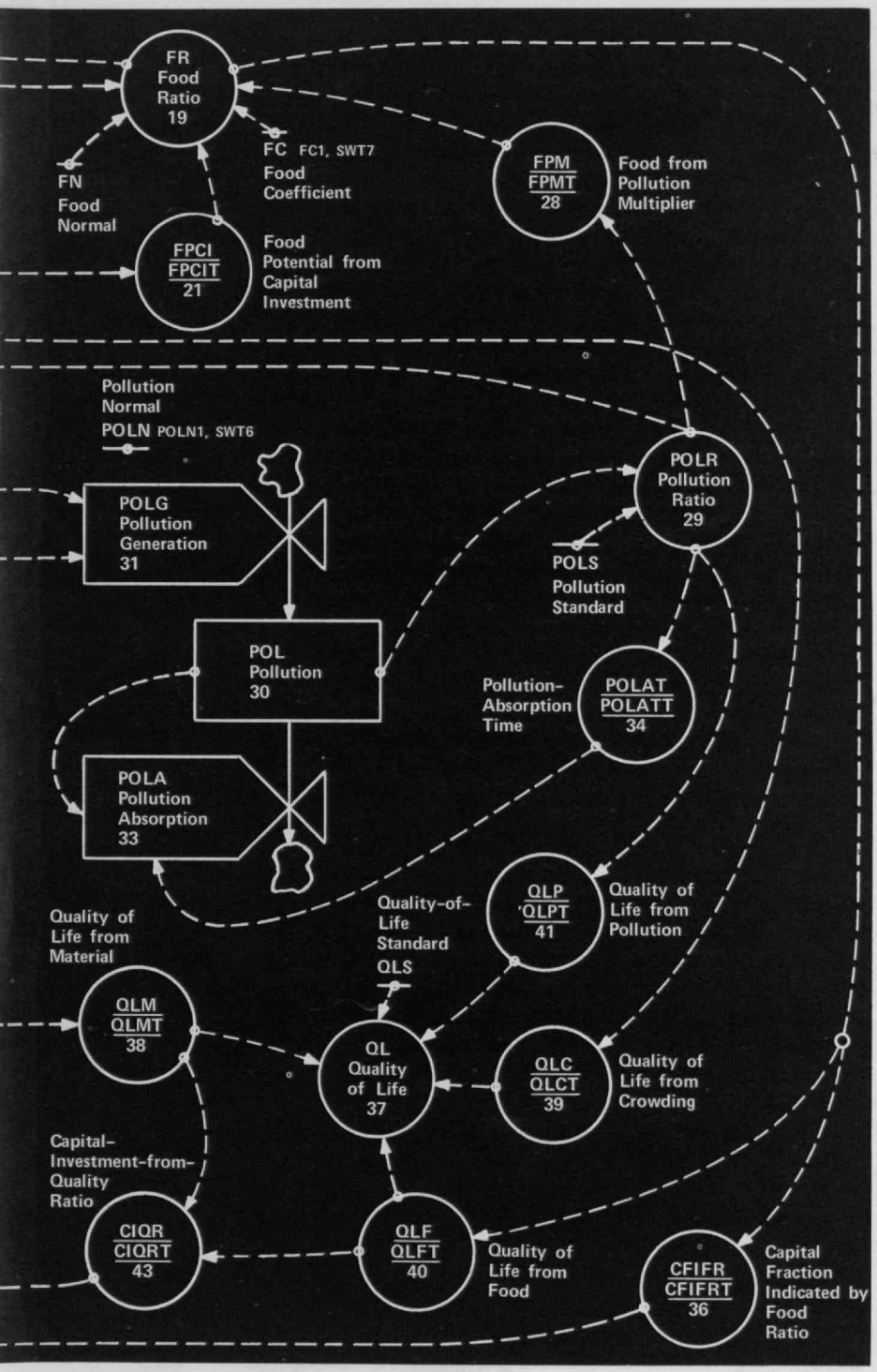
Dynamics of Urban Systems

Our first major excursion outside of corporate policy began in February, 1968, when John F. Collins, former mayor of Boston, became Professor of Urban Affairs at M.I.T. He and I discussed my work in industrial dynamics and his experience with urban difficulties. A close collaboration led to applying to the dynamics of the city the same methods that had been created for understanding the social and policy structure of the corporation. A model structure was developed to represent the fundamental urban processes. The proposed structure shows how industry, housing, and people interact with each other as a city grows and decays. The results are described in my book *Urban Dynamics,* and some were summarized in *Technology Review* (*April, 1969, pp. 21-31*).

I had not previously been involved with urban behavior or urban policies. But the emerging story was strikingly similar to what we had seen in the corporation. Actions taken to alleviate the difficulties of a city can actually make matters worse. We examined four common programs for improving the depressed nature of the central city. One is the creation of jobs as by bussing the unemployed to the suburbs or through governmental jobs as employer of last resort. Second was a training program to increase the skills of the lowest-income group. Third was financial aid to the depressed city as by federal subsidy. Fourth was the construction of low-cost housing. All of these are shown to lie between neutral and detrimental almost irrespective of the criteria used for judgment. They range from ineffective to harmful judged either by their effect on the economic health of the city or by their long-range effect on the low-income population of the city.

Figure 1. *Upon this world model are based the author's analyses of the effects of changing population and economic growth factors in the next 50 years. It shows the interrelation of population, capital investment, natural resources, pollution, and the fraction of capital devoted to agriculture on which is based the following discussion.*





The results both confirm and explain much of what has been happening over the last several decades in our cities.

In fact, it emerges that the fundamental cause of depressed areas in the cities comes from *excess* housing in the low-income category rather than the commonly presumed housing shortage. The legal and tax structures have combined to give incentives for keeping old buildings in place. As industrial buildings age, the employment opportunities decline. As residential buildings age, they are used by lower-income groups who are forced to use them at a higher population density. Therefore, jobs decline and population rises while buildings age. Housing, at the higher population densities, accommodates more low-income urban population than can find jobs. A social trap is created where excess low-cost housing beckons low-income people inward because of the available housing. They continue coming to the city until their numbers so far exceed the available income opportunities that the standard of living declines far enough to stop further inflow. Income to the area is then too low to maintain all of the housing. Excess housing falls into disrepair and is abandoned. One can simultaneously have extreme crowding in those buildings that are occupied, while other buildings become excess and are abandoned because the economy of the area cannot support all of the residential structures. But the excess residential buildings threaten the area in two ways—they occupy the land so that it cannot be used for job-creating buildings, and they stand ready to accept a rise in population if the area should start to improve economically.

Any change which would otherwise raise the standard of living only takes off the economic pressure momentarily and causes the population to rise enough that the standard of living again falls to the barely tolerable level. A self-regulating system is thereby at work which drives the condition of the depressed area down far enough to stop the increase in people.

At any time, a near-equilibrium exists affecting population mobility between the different areas of the country. To the extent that there is disequilibrium, it means that some area is slightly more attractive than others and population begins to move in the direction of the more attractive area. This movement continues until the rising population drives the more attractive area

down in attractiveness until the area is again in equilibrium with its surroundings. Other things being equal, an increase in population of a city crowds housing, overloads job opportunities, causes congestion, increases pollution, encourages crime, and reduces almost every component of the quality of life.

This powerful dynamic force to re-establish an equilibrium in total attractiveness means that any social program must take into account the eventual shifts that will occur in the many components of *attractiveness.* As used here, attractiveness is the composite effect of all factors that cause population movement toward or away from an area. Most areas in a country have nearly equal attractiveness most of the time, with only sufficient disequilibrium in attractiveness to account for the shifts in population. But areas can have the same composite attractiveness with different mixes in the components of attractiveness. In one area component A could be high and B low, while the reverse could be true in another area that nevertheless had the same total composite attractiveness. If a program makes some aspect of an area more attractive than its neighbor's, and thereby makes total attractiveness higher momentarily, population of that area rises until other components of attractiveness are driven down far enough to again establish an equilibrium. This means that efforts to improve the condition of our cities will result primarily in increasing the population of the cities and causing the population of the country to concentrate in the cities. The overall condition of urban life, for any particular economic class of population, cannot be appreciably better or worse than that of the remainder of the country to and from which people may come. Programs aimed at improving the city can succeed only if they result in eventually raising the average quality of life for the country as a whole.

On Raising the Quality of Life

But there is substantial doubt that our urban programs have been contributing to the national quality of life. By concentrating total population, and especially low-income population, in urban locations, undermining the strength and cohesiveness of the community, and making government and bureaucracy so big that the individual feels powerless to influence the system within which he is increasingly constrained, the quality of life is being reduced. In fact, if they have any effect, our efforts to improve our urban areas will in the long run tend to delay the concern about rising total population and thereby contribute directly to the eventual overcrowding of the country and the world.

Any proposed program must deal with both the quality of life and the factors affecting population. "Raising the quality of life" means releasing stress and pressures, reducing crowding, reducing pollution, alleviating hunger, and treating ill health. But these pressures are exactly the sources of concern and action aimed at controlling total population to keep it within the bounds of the fixed world within which we live. If the pressures are relaxed, so is the concern about how we impinge on the environment. Population will then rise further until the pressures reappear with an intensity that can no longer be relieved. To try to raise quality of life without intentionally creating compensating pressures to prevent a rise in population density will be self-defeating.

Consider the meaning of these interacting attractiveness components as they affect a depressed ghetto area of a city. First we must be clear on the way population density is, in fact, now being controlled. There is some set of forces determining that the density is not far higher or lower than it is. But there are many possible combinations of forces that an urban area can exert. The particular combination will determine the population mix of the area and the economic health of the city. I suggest that the depressed areas of most American cities are created by a combination of forces in which there is a job shortage and a housing excess. The availability of housing draws the lowest-income group until they so far exceed the opportunities of the area that the low standard of living, the frustration, and the crime rate counterbalance the housing availability. Until the pool of excess housing is reduced, little can be done to improve the economic condition of the city. A low-cost housing program alone moves exactly in the wrong direction. It draws more low-income people. It makes the area differentially more attractive to the poor who need jobs and less attractive to those who create jobs. In the new population equilibrium that develops, some characteristic of the social system must compensate for the additional attractiveness created by the low-cost housing. The counterbalance is a further decline of the economic condition for the area. But as the area becomes more destitute, pressures rise for more low-cost housing. The consequence is a downward spiral that draws in the low-income population, depresses their condition, prevents escape, and reduces hope. All of this is done with the best of intentions.

My paper, "Systems Analysis as a Tool for Urban Planning" from a symposium in October, 1969, at the National Academy of Engineering, suggests a reversal of present practice in order to simultaneously reduce the aging housing in our cities and allocate land to income-earning opportunities. The land shifted to industry permits the "balance of trade" of the area to be corrected by allowing labor to create and export a product to generate an income stream with which to buy the necessities of modern life from the outside. But the concurrent reduction of excess housing is absolutely essential. It supplies the land for new jobs. Equally important, the resulting housing shortage creates the population-stabilizing pressure that allows economic revival to proceed without being inundated by rising population. This can all be done without driving the present low-income residents out of the area. It can create *upward economic mobility* to convert the low-income population to a self-supporting basis.

The first reaction of many people to these ideas is to believe that they will never be accepted by elected officials or by residents of depressed urban areas. But some of our strongest support and encouragement is coming from those very groups who are closest to the problems, who see the symptoms first-hand, who have lived through the failures of the past, and who must

live with the present conditions until enduring solutions are found.

Over the last several decades the country has slipped into a set of attitudes about our cities that are leading to actions that have become an integral part of the system that is generating greater troubles. If we were malicious and wanted to create urban slums, trap low-income people in ghetto areas, and increase the number of people on welfare, we could do little better than follow the present policies. The trend toward stressing income and sales taxes and away from the real estate tax encourages old buildings to remain in place and block self-renewal. The concessions in the income tax laws to encourage low-income housing will in the long run actually increase the total low-income population of the country. The highway expenditures and the government loans for suburban housing have made it easier for higher-income groups to abandon urban areas than to revive them. The pressures to expand the areas incorporated by urban government, in an effort to expand the revenue base, have been more than offset by lowered administrative efficiency, more citizen frustration, and the accelerated decline that is triggered in the annexed areas. The belief that more money will solve urban problems has taken attention away from correcting the underlying causes and has instead allowed the problems to grow to the limit of the available money, whatever that amount might be.*

Characteristics of Social Systems

I turn now to some characteristics of social systems that mislead people. These have been identified in our work with corporate and urban systems and in more recent work that I will describe concerning the world-wide pressures that are now enveloping our planet.

First, social systems are inherently insensitive to most policy changes that people select in an effort to alter the behavior of the system. In fact, a social system tends to draw our attention to the very points at which an attempt to intervene will fail. Our experience, which has been developed from contact with simple systems, leads us to look close to the symptoms of trouble for a cause. When we look, we discover that the social system presents us with an apparent cause that is plausible according to what we have learned from simple systems. But this apparent cause is usually a coincident occurrence that, like the trouble symptom itself, is being produced by the feedback-loop dynamics of a larger system. For example, as already discussed, we see human suffering in the cities; we observe that it is accompanied (some think caused) by inadequate housing. We increase the housing and the population rises to compensate for the effort. More people are drawn into and trapped in the depressed social system. As another example, the symptoms of excess population are beginning to overshadow the country. These symptoms appear as urban crowding and social pressure. Rather than face the population problem squarely we try to relieve the immediate pressure by planning industry in rural areas and by discussing new towns. If additional urban area is provided it will temporarily reduce the pressures and defer the need to face the underlying population question. The consequence, as it will be seen 25 years hence, will have been to contribute to increasing the population so much that even today's quality of life will be impossible.

A second characteristic of social systems is that all of them seem to have a few sensitive influence points through which the behavior of the system can be changed. These influence points are not in the locations where most people expect. Furthermore, if one identifies in a model of a social system a sensitive point where influence can be exerted, the chances are still that a person guided by intuition and judgment will alter the system in the wrong direction. For example in the urban system, housing is a sensitive control point but, if one wishes to revive the economy of a city and make it a better place for low-income as well as other people, it appears that the amount of low-income housing must be reduced rather than increased. Another example is the world-wide problem of rising population and the disparity between the standards of living in the developed and the underdeveloped countries, an issue arising in the world system to be discussed in the following paragraphs. But it is beginning to appear that a sensitive control point is the rate of generation of capital investment.

And how should one change the rate of capital accumulation? The common answer has been to increase industrialization, but recent examination suggests that hope lies only in reducing the rate of industrialization. This may actually help raise quality of life and contribute to stabilizing population.

As a third characteristic of social systems, there is usually a fundamental conflict between the short-term and long-term consequences of a policy change. A policy which produces improvement in the short run, within five to ten years, is usually one which degrades the system in the long run, beyond ten years. Likewise, those policies and programs which produce long-run improvement may initially depress the behavior of the system. This is especially treacherous. The short run is more visible and more compelling. It speaks loudly for immediate attention. But a series of actions all aimed at short-run improvement can eventually burden a system with long-run depressants so severe that even heroic short-run measures no longer suffice. Many of the problems which we face today are the eventual result of short-run measures taken as long as two or three decades ago.

A Global Perspective

I have mentioned social organizations at the corporate level and then touched on work which has been done on the dynamics of the city. Now we are beginning to examine issues of even broader scope.

In July, 1970, we held a two-week international conference on world dynamics. It was a meeting organized for the Club of Rome, a private group of about 50

*Our continuing examination of urban behavior has been made possible through a grant to M.I.T. from the Independence Foundation of Philadelphia.

individuals drawn from many countries who have joined together to attempt a better understanding of social systems at the world level. Their interest lies in the same problems of population, resources, industrialization, pollution, and world-wide disparities of standard of living on which many groups now focus. But the Club of Rome is devoted to taking actions that will lead to a better understanding of world trends and to influencing world leaders and governments. The July meeting at M.I.T. included the general theory and behavior of complex systems and talks on the behavior of specific social systems ranging from corporations through commodity markets to biological systems, drug addiction in the community, and growth and decline of a city. Especially prepared for this conference was a dynamic model of the interactions between world population, industrialization, depletion of natural resources, agriculture, and pollution. A detailed discussion of this world system will soon appear in my book *World Dynamics,* and its further development is the purpose of the "Project on the Predicament of Mankind" being sponsored by the Club of Rome at M.I.T. for a year under the guidance of Professor Dennis Meadows. The plan is to develop a research group of men from many countries who will eventually base their continuing efforts in a neutral country such as Switzerland. The immediate project will reexamine, verify, alter, and extend the preliminary dynamic study of the world system and will relate it to the present world-wide concern about trends in civilization.

The simple model of world interactions as thus far developed shows several different alternative futures depending on whether population growth is eventually suppressed by shortage of natural resources, by pollution, by crowding and consequent social strife, or by insufficient food. Malthus dealt only with the latter, but it is possible for civilization to encounter other controlling pressures before a food shortage occurs.

It is certain that resource shortage, pollution, crowding, food failure, or some other equally powerful force will limit population and industrialization if persuasion and psychological factors do not. Exponential growth cannot continue forever. Our greatest immediate challenge is how we guide the transition from growth to equilibrium. There are many possible mechanisms of growth suppression. That some one or combination will occur is inevitable. Unless we come to understand and to choose, the social system by its internal processes will choose for us. The natural mechanisms for terminating exponential growth appear to be the least desirable. Unless we understand and begin to act soon, we may be overwhelmed by a social and economic system we have created but can't control.

Figure 1* shows the structure that has been assumed. It interrelates the mutual effects of population, capital investment, natural resources, pollution, and the fraction of capital devoted to agriculture. These five system "levels" are shown in the rectangles. Each level is

*All figures are taken from the manuscript for *World Dynamics* by Jay W. Forrester, Wright-Allen Press, 238 Main Street, Cambridge, Mass. 02142, available about February, 1971.

Figure 2. *Basic world model behavior showing the mode in which industrialization and population are suppressed by falling natural resources.*

Figure 3. *Pollution crisis precipitated by lower usage rate of natural resources. In 1970 natural resource usage is reduced 75 per cent by more effective technology without affecting material standard of living.*

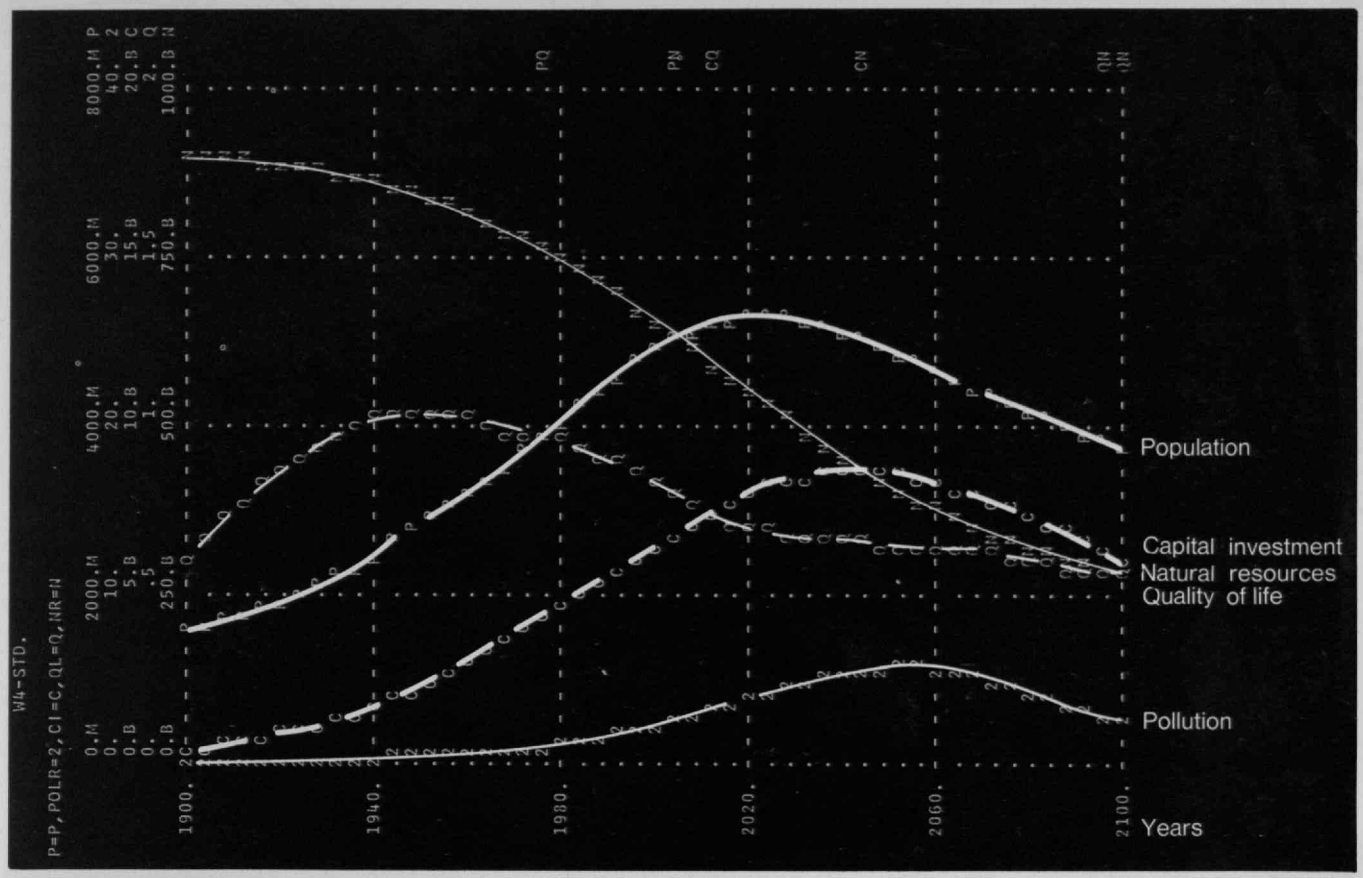
caused to change by the rates of flow in and out, such as the birth rate and death rate that increase and decrease population. As shown by the dotted lines, the five system levels, through intermediate concepts shown at the circles, control the rates of flow. As an example, the death rate at Symbol 10 depends on population P and the "normal" lifetime as stated by death rate normal DRN. But death rate depends also on conditions in other parts of the system. From Circle 12 comes the influence of pollution that here assumes death rate to double if pollution becomes 20 times as severe as in 1970; and, progressively, that death rate would increase by a factor of 10 if pollution became 60 times as much as now. Likewise from Circle 13 the effect of food per capita is to increase death rate as food becomes less available. The detailed definition of the model states how each rate of flow is assumed to depend on the levels of population, natural resources, capital investment, capital devoted to food, and pollution.

Individually the assumptions in the model are plausible, create little disagreement, and reflect common discussions and assertions about the individual responses within the world system. But each is explicit and can be subjected to scrutiny. From one viewpoint, the system of Figure 1 is very simplified. It focuses on a few major factors and omits most of the substructure of world social and economic activity. But from another viewpoint, Figure 1 is comprehensive and complex. The system is far more complete and the theory described by the accompanying computer model is much more explicit than the mental models that are now being used as a basis for world and governmental planning. It incorporates dozens of nonlinear relationships. The world system shown here exhibits provocative and even frightening possibilities.

Transition from Growth to Equilibrium

With the model specified, a computer can be used to show how the system, as described for each of its parts, would behave. Given a set of beginning conditions, the computer can calculate and plot the results that unfold through time.

The world today seems to be entering a condition in which pressures are rising simultaneously from every one of the influences that can suppress growth—depleted resources, pollution, crowding, and insufficient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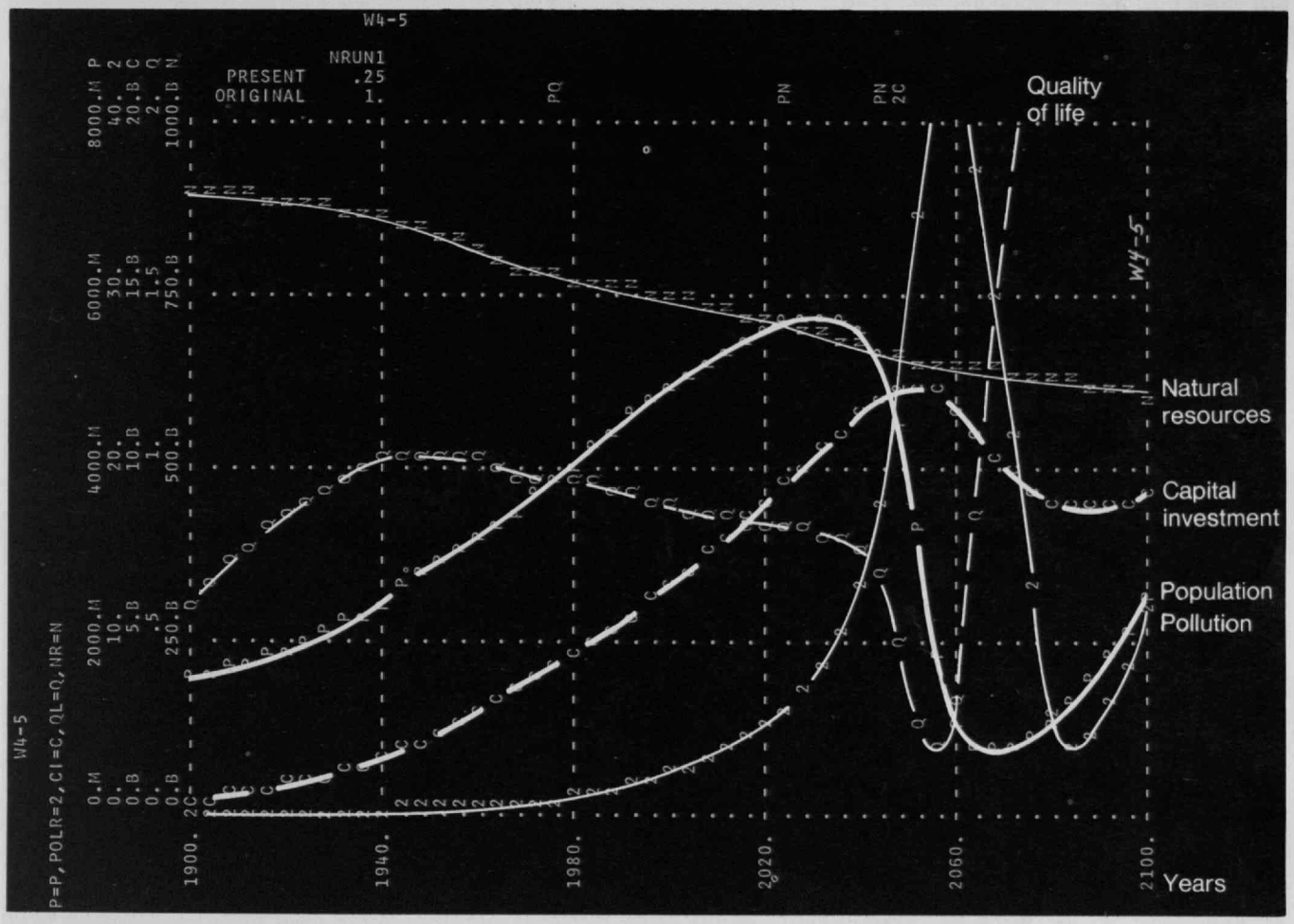
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Quality of life
Natural resources
Capital investment
Population
Pollution
Years

Figure 4. *In 1970 the rate of capital accumulation is increased 20 per cent in an effort to reverse the beginning decline in quality of life. The pollution crisis occurs before natural resources are depleted.*

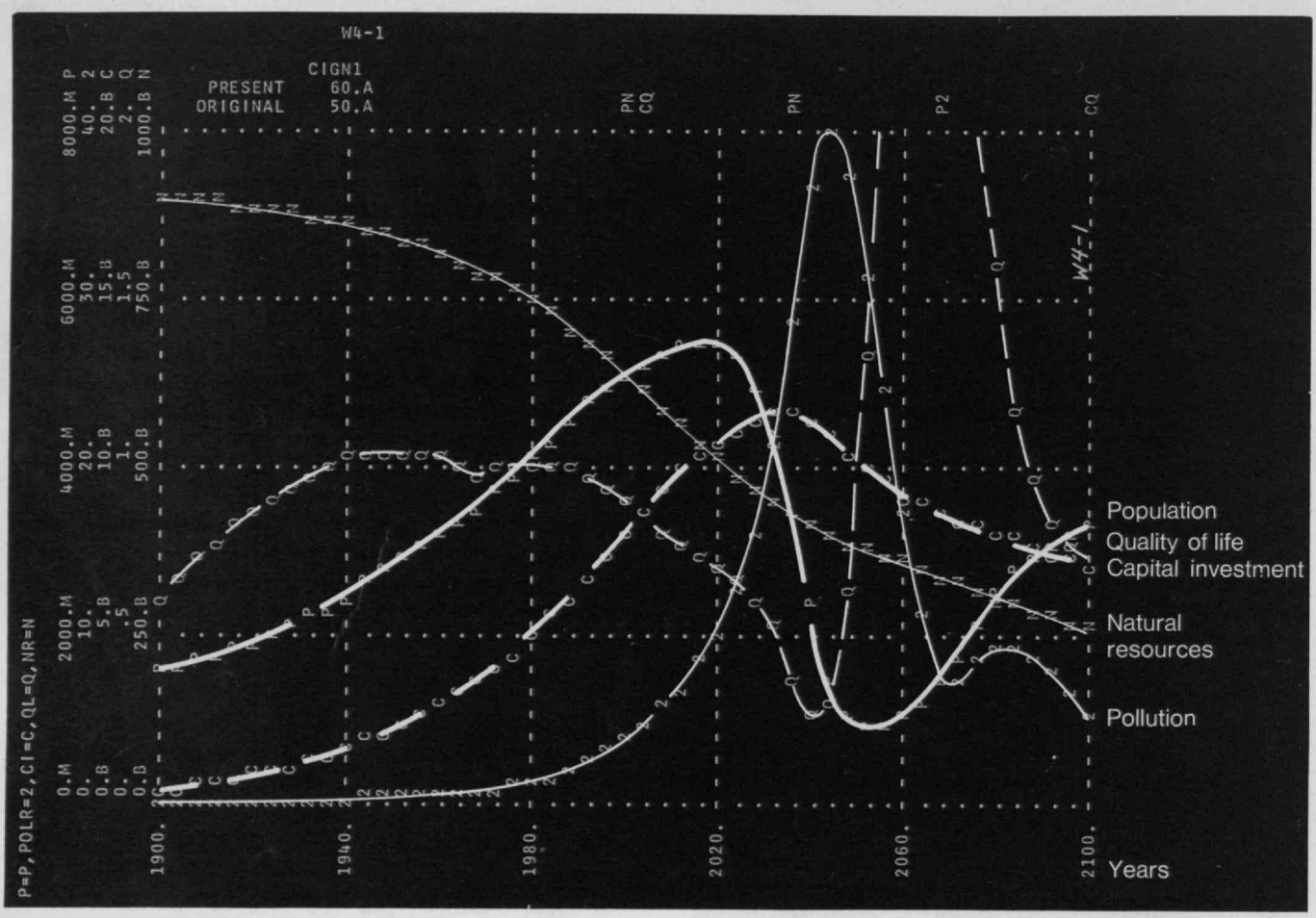
Figure 5. *In 1970 the 20 per cent increase in capital accumulation of Figure 4 is retained and "normal" birth rate is reduced 50 per cent. Capital investment continues to grow until the pollution crisis develops. After an initial decline, population is again pushed up by the rapid rise in quality of life that precedes the collapse.*

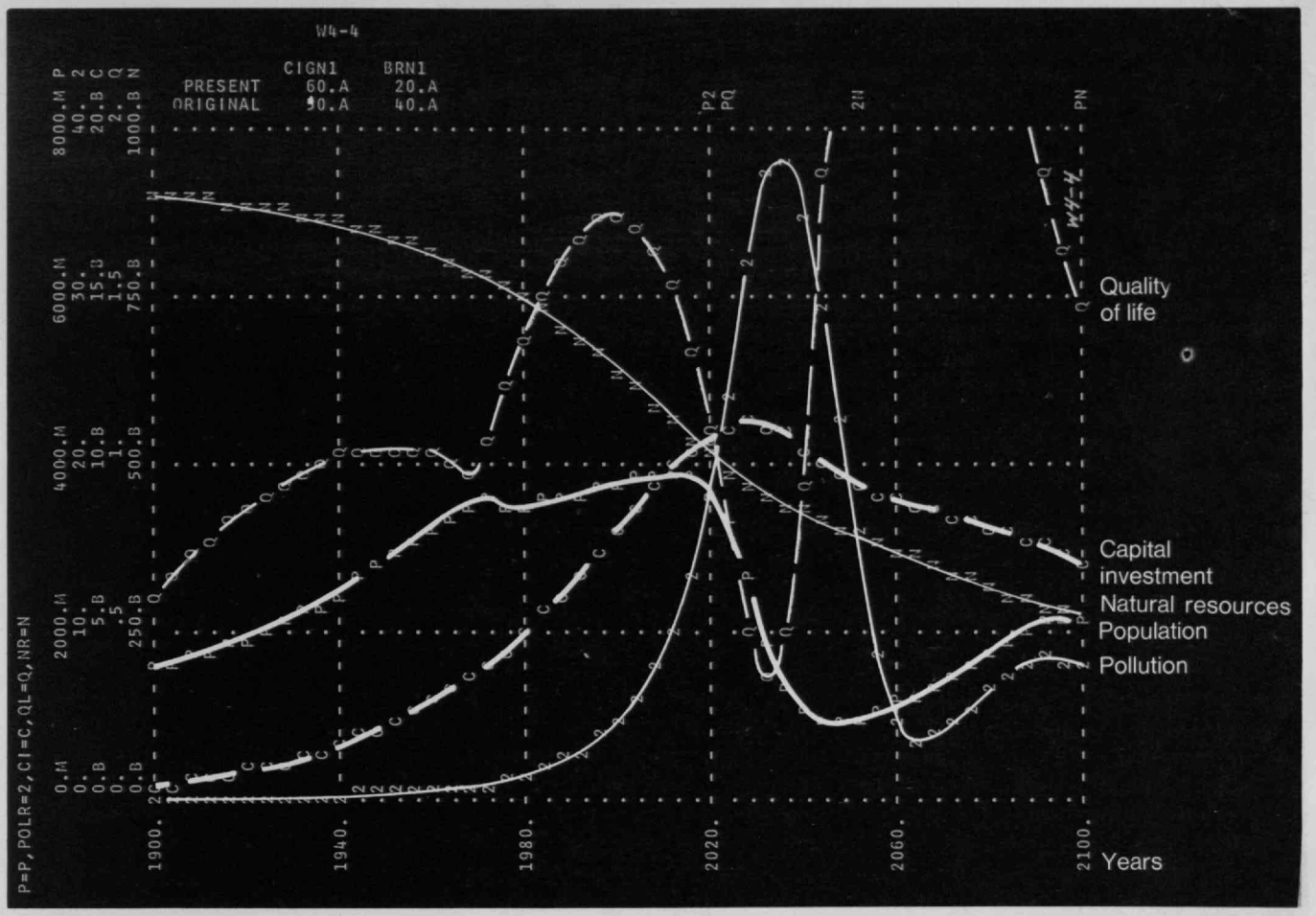
Figure 6. *The 20 per cent increase of capital investment from Figure 4 and the 75 per cent reduction of natural resource usage from Figure 3 are combined.*

food. It is still unclear which will dominate if mankind continues along the present path. Figure 2 shows the mode of behavior of this world system given the assumption that population reaches a peak and then declines because industrialization is suppressed by falling natural resources. The model system starts with estimates of conditions in 1900. Adjustments have been made so that the generated paths pass through the conditions of 1970.

In Figure 2 the quality of life peaks in the 1950's and by 2020 has fallen far enough to halt further rise in population. Declining resources and the consequent fall in capital investment then exert further pressure to gradually reduce world population.

But we may not be fortunate enough to run gradually out of natural resources. Science and technology may very well find ways to use the more plentiful metals and atomic energy so that resource depletion does not intervene. If so, the way then remains open for some other pressure to arise within the system. Figure 3 shows what happens within this system if the resource shortage is foreseen and avoided. Here the only change from Figure 2 is in the usage rate of natural resources after the year 1970. In Figure 3, resources are used after 1970 at a rate 75 per cent less than assumed in Figure 2. In other words, the standard of living is sustained with a lower drain on the expendable and irreplaceable resources. But the picture is even less attractive! By not running out of resources, population and capital investment are allowed to rise until a pollution crisis is created. Pollution then acts directly to reduce birth rate, increase death rate, and to depress

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Quality of life
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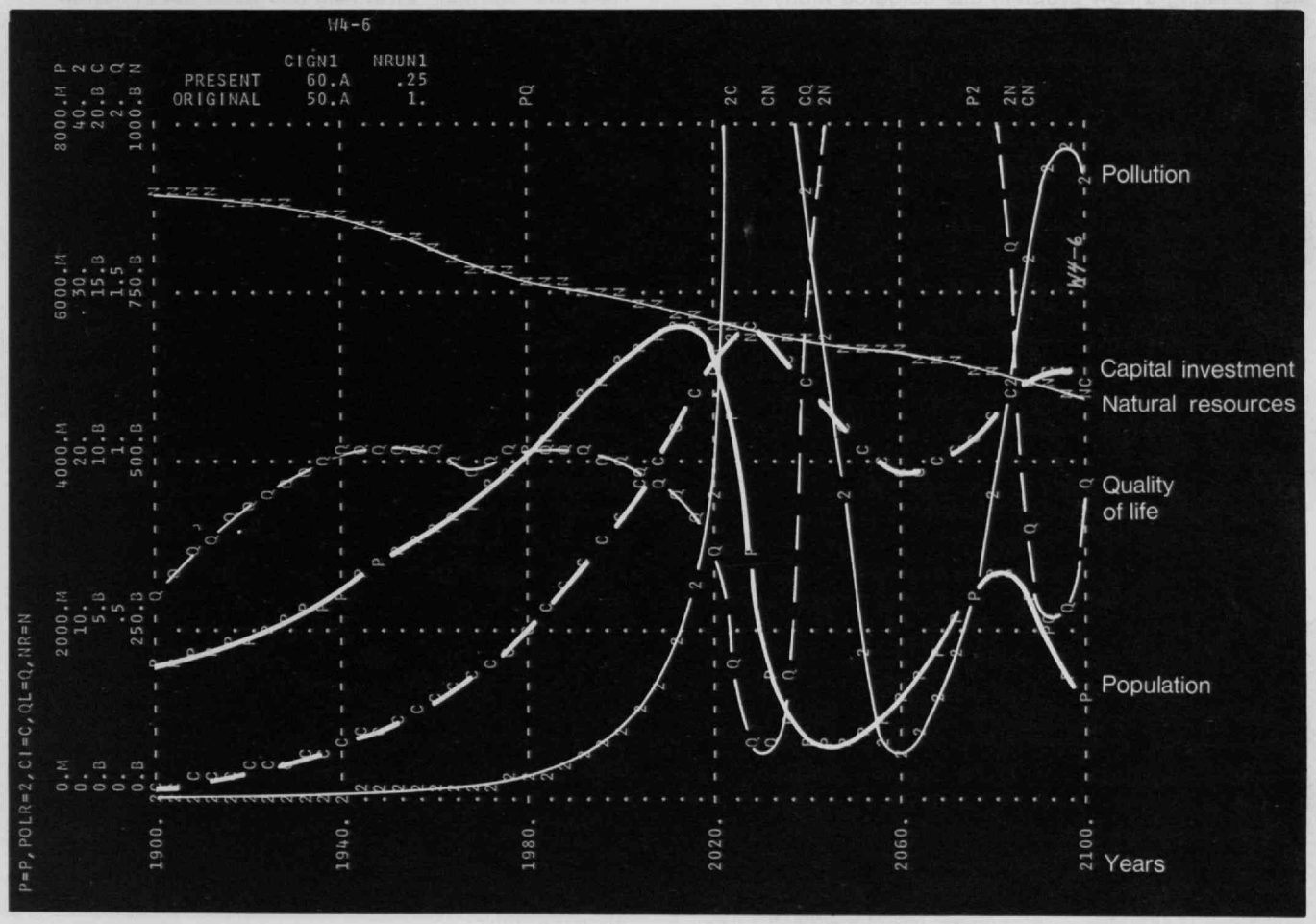
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Capital investment
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Quality of life
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P=P, POLR=2, CI=C, QL=Q, NR=N

food production. Population which, according to this simple model, peaks at the year 2030 has fallen to one-sixth of the peak population within an interval of 20 years—a world-wide catastrophe of a magnitude never before experienced. Should it occur, one can speculate on which sectors of the world population will suffer most. It is quite possible that the more industrialized countries (which are the ones which have caused such a disaster) would be the least able to survive such a disruption to environment and food supply. They might be the ones to take the brunt of the collapse.

Figure 3 shows how a technological success (reducing our dependence on natural resources) can merely save us from one fate only to fall victim to something worse (a pollution catastrophe). There is now developing throughout the world a strong undercurrent of doubt about technology as the savior of mankind. There is a basis for such doubt. Of course, the source of trouble is not technology as such but is instead the management of the entire technological-human-political-economic-natural complex.

Figure 3 is a dramatic example of the general process discussed earlier wherein a program aimed at one trouble symptom results in creating a new set of troubles in some other part of the system. Here the success in alleviating a natural resource shortage throws the system over into the mode of stopping population caused by industrialization which has been freed from natural resource restraint. This process of a solution creating a new problem has defeated many of our past governmental programs and will continue to do so unless we devote more effort to understanding the dynamic behavior of our social systems.

Alternatives to Decline or Catastrophe

Suppose in the basic world system of Figures 1 and 2 we ask how to sustain the quality of life which is beginning to decline after 1950. One way to attempt this, and it is the way the world is now choosing, might be to increase the rate of industrialization by raising the rate of capital investment. Models of the kind we are here using make such hypothetical questions answerable in a few minutes and at negligible cost. Figure 4 shows what happens if the "normal" rate of capital accumulation is increased by 20 per cent in 1970. The pollution crisis reappears. This time the cause is not the more efficient use of natural resources but the upsurge of industrialization which overtaxes the environment before resource depletion has a chance to depress industrialization. Again, an "obvious" desirable change in policy has caused troubles worse than the ones that were originally being corrected.

This is important, not only for its own message but because it demonstrates how an apparently desirable change in a social system can have unexpected and even disastrous results.

Figure 4 should make us cautious about rushing into programs on the basis of short-term humanitarian impulses. The eventual result can be anti-humanitarian. Emotionally inspired efforts often fall into one of three

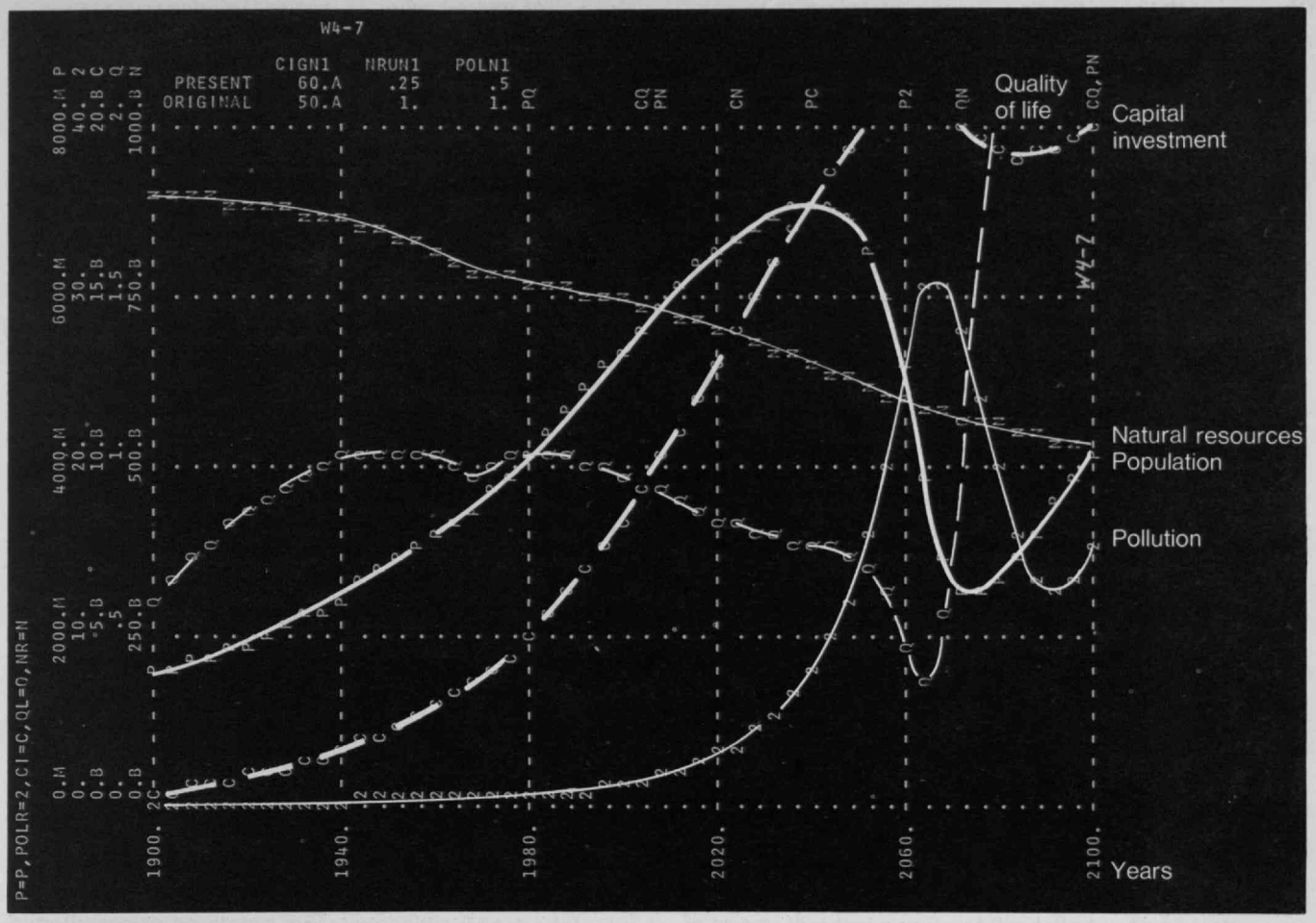
Figure 7. *Increased capital investment rate and reduced natural resource usage from Figure 6 are retained. In addition in 1970 the "normal" rate of pollution generation is reduced 50 per cent. The effect of pollution control is to allow population to grow 25 per cent further and to delay the pollution crisis by 20 years.*

Figure 8. *One set of conditions that establishes a world equilibrium. In 1970 capital investment rate is reduced 40 per cent, birth rate is reduced 50 per cent, pollution generation is reduced 50 per cent, natural resource usage rate is reduced 75 per cent, and food production is reduced 20 per cent.*

traps set for us by the nature of social systems: The programs are apt to address symptoms rather than causes and attempt to operate through points in the system that have little leverage for change; the characteristic of systems whereby a policy change has the opposite effect in the short run from the effect in the long run can eventually cause deepening difficulties after a sequence of short-term actions; and the effect of a program can be along an entirely different direction than was originally expected, so that suppressing one symptom only causes trouble to burst forth at another point.

Figure 5 retains the 20 per cent additional capital investment rate after 1970 from Figure 4 but in addition explores birth reduction as a way of avoiding crisis. Here the "normal" birth rate has been cut in half in 1970. (Changes in normal rates refer to coefficients which have the specified effect if all other things remain the same. But other things in the system change and also exert their effect on the actual system rates.) The result shows interesting behavior. Quality of life surges upward for 30 years for the reasons that are customarily asserted. Food-per-capita grows, material standard of living rises, and crowding does not become as great. But the more affluent world population continues to use natural resources and to accumulate capital plant at about the same rate as in Figure 4. Load on the environment is more closely related to industrialization than to population and the pollution crisis occurs at about the same point in time as in Figure 4.

Figure 5 shows that the 50 per cent reduction in "normal" birth rate in 1970 was sufficient to start a decline in total population. But the rising quality of life and the reduction of pressures act to start the population curve upward again. This is especially evident in other computer runs where the reduction in "normal" birth rate is not so drastic. Serious questions are raised by this investigation about the effectiveness of birth control as a means of controlling population. The secondary consequence of starting a birth control program will be to increase the influences that raise birth rate and reduce the apparent pressures that require population control. A birth control program which would be effective, all other things being equal, may largely fail because other things will not remain equal. Its very incipient success can set in motion forces to defeat the program.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Quality of life
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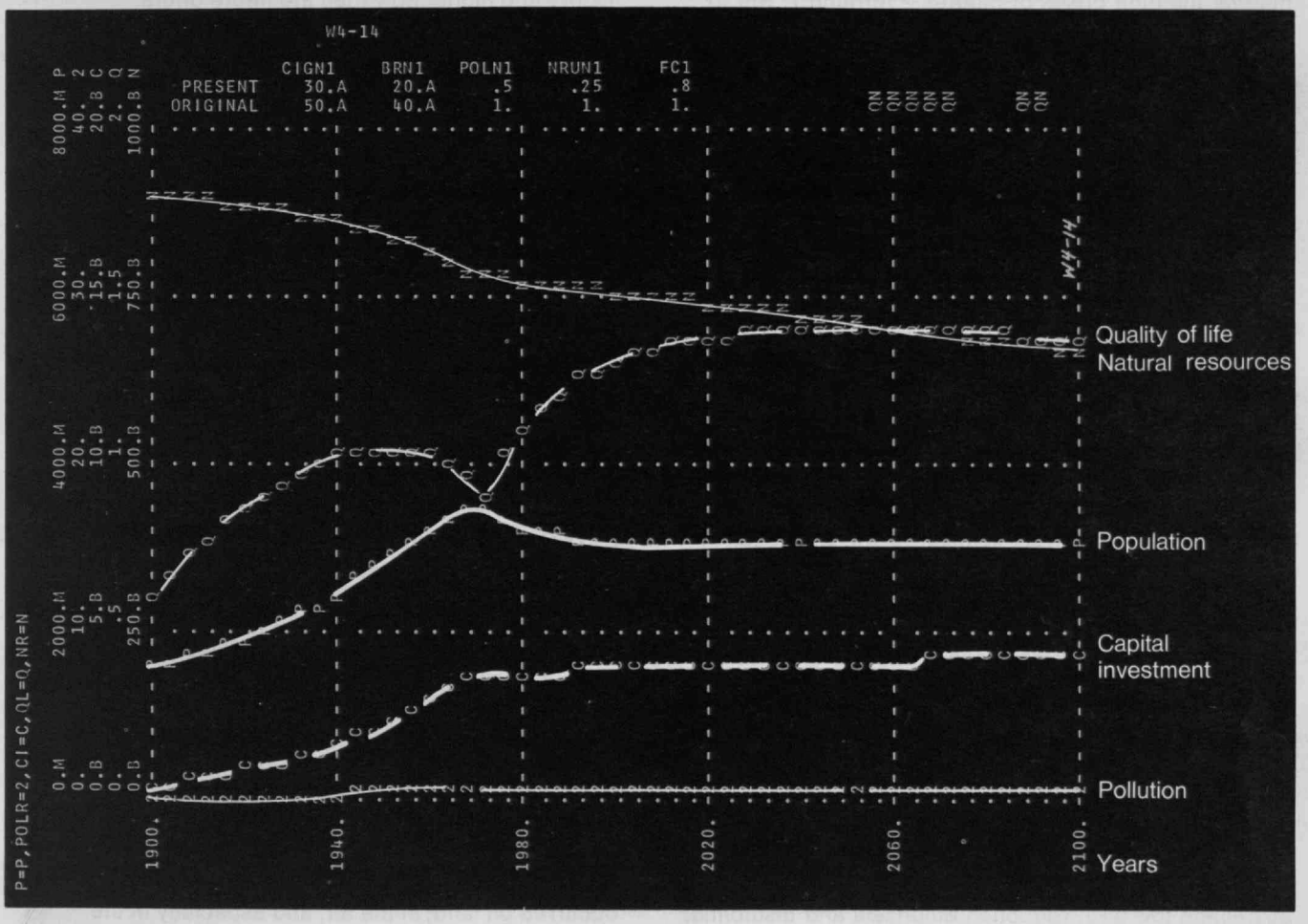
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Quality of life
Natural resources
Population
Capital investment
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Years
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Figure 6 combines the reduced resource usage rate and the increased capital investment rate of Figures 3 and 4. The result is to make the population collapse occur slightly sooner and more severely. Based on the modified system of Figure 6, Figure 7 then examines the result if technology finds ways to reduce the pollution generated by a given degree of industrialization. Here in Figure 7, the pollution rate, other things being the same, is reduced by 50 per cent from that in Figure 6. The result is to postpone the day of reckoning by 20 years and to allow the world population to grow 25 per cent greater before the population collapse occurs. The "solution" of reduced pollution has, in effect, caused more people to suffer the eventual consequences. Again we see the dangers of partial solutions. Actions at one point in a system that attempt to relieve one kind of distress produce an unexpected result in some other part of the system. If the interactions are not sufficiently understood, the consequences can be as bad as or worse than those that led to the initial action.

There are no utopias in our social systems. There appear to be no sustainable modes of behavior that are free of pressures and stresses. But there are many possible modes and some are more desirable than others. Usually, the more attractive kinds of behavior in our social systems seem to be possible only if we have a good understanding of the system dynamics and are willing to endure the self-discipline and pressures that must accompany the desirable mode. The world system of Figure 1 can exhibit modes that are more hopeful than the crises of Figures 2 through 7. But to develop the more promising modes will require restraint and dedication to a long-range future that man may not be capable of sustaining.

Figure 8 shows the world system if several policy changes are adopted together in the year 1970. Population is stabilized. Quality of life rises about 50 per cent. Pollution remains at about the 1970 level. Would such a world be accepted? It implies an end to population and economic growth.

In Figure 8 the normal rate of capital accumulation is *reduced* 40 per cent from its previous value. The "normal" birth rate is reduced 50 per cent from its earlier value. The "normal" pollution generation is reduced 50 per cent from the value before 1970. The "normal" rate of food production is *reduced* 20 per cent from its previous value. (These changes in "normal" values are the changes for a specific set of system conditions. Actual system rates continue to be affected by the varying conditions of the system.) But reduction in investment rate and reduction in agricultural emphasis are counterintuitive and not likely to be discovered or accepted without extensive system studies and years of argument—perhaps more years than are available. The changes in pollution generation and natural resource usage may be easier to understand and to achieve. The severe reduction in world-wide birth rate is the most doubtful. Even if technical and biological methods existed, the improved condition of the world might remove the incentive for sustaining the birth reduction emphasis and discipline.

Future Policy Issues

The dynamics of world behavior bear directly on the future of the United States. American urbanization and industrialization are a major part of the world scene. The United States is setting a pattern that other parts of the world are trying to follow. That pattern is not sustainable. Our foreign policy and our overseas commercial activity seem to be running contrary to overwhelming forces that are developing in the world system. The following issues are raised by the preliminary investigations to date. They must, of course, be examined more deeply and confirmed by more thorough research into the assumptions about structure and detail of the world system.

◇ Industrialization may be a more fundamentally disturbing force in world ecology than is population. In fact, the population explosion is perhaps best viewed as a result of technology and industrialization. I include medicine and public health as a part of industrialization.

◇ Within the next century, man may be facing choices from a four-pronged dilemma—suppression of modern industrial society by a natural resource shortage, collapse of world population from changes wrought by pollution, population limitation by food shortage, or population control by war, disease, and social stresses caused by physical and psychological crowding.

◇ We may now be living in a "golden age" where, in spite of the world-wide feeling of malaise, the quality of life is, on the average, higher than ever before in history and higher now than the future offers.

◇ Efforts for direct population control may be inherently self-defeating. If population control begins to result as hoped in higher per capita food supply and material standard of living, these very improvements can generate forces to trigger a resurgence of population growth.

◇ The high standard of living of modern industrial societies seems to result from a production of food and material goods that has been able to outrun the rising population. But, as agriculture reaches a space limit, as industrialization reaches a natural-resource limit, and as both reach a pollution limit, population tends to catch up. Population then grows until the "quality of life" falls far enough to generate sufficiently large pressures to stabilize population.

◇ There may be no realistic hope for the present underdeveloped countries reaching the standard of living demonstrated by the present industrialized nations. The pollution and natural resource load placed on the world environmental system by each person in an advanced country is probably 20 to 50 times greater than the load now generated by a person in an underdeveloped country. With four times as much population in underdeveloped countries as in the present developed countries, their rising to the economic level of the United States could mean an increase of 200 times in the natural resource and pollution load on the world environment. Noting the destruction that has already occurred on land, in the air, and especially in the

oceans, no capability appears to exist for handling such a rise in standard of living for the present total population of the world.

◇ A society with a high level of industrialization may be nonsustainable. It may be self-extinguishing if it exhausts the natural resources on which it depends. Or, if unending substitution for declining natural resources is possible, the international strife over "pollution and environmental rights" may pull the average world-wide standard of living back to the level of a century ago.

◇ From the long view of a hundred years hence, the present efforts of underdeveloped countries to industrialize along Western patterns may be unwise. They may now be closer to the ultimate equilibrium with the environment than are the industrialized nations. The present underdeveloped countries may be in a better condition for surviving the forthcoming world-wide environmental and economic pressures than are the advanced countries. When one of the several forces materializes that is strong enough to cause a collapse in world population, the advanced countries may suffer far more than their share of the decline.

A New Frontier

It is now possible to take hypotheses about the separate parts of a social system, to combine them in a computer model, and to learn the consequences. The hypotheses may at first be no more correct than the ones we are using in our intuitive thinking. But the process of computer modeling and model testing requires these hypotheses to be stated more explicitly. The model comes out of the hazy realm of the mental model into an unambiguous model or statement to which all have access. Assumptions can then be checked against all available information and can be rapidly improved. The great uncertainty with mental models is the inability to anticipate the consequences of interactions between the parts of a system. This uncertainty is totally eliminated in computer models. Given a stated set of assumptions, the computer traces the resulting consequences without doubt or error. This is a powerful procedure for clarifying issues. It is not easy. Results will not be immediate.

We are on the threshold of a great new era in human pioneering. In the past there have been periods characterized by geographical exploration. Other periods have dealt with the formation of national governments. At other times the focus was on the creation of great literature. Most recently we have been through the pioneering frontier of science and technology. But science and technology are now a routine part of our life. Science is no longer a frontier. The process of scientific discovery is orderly and organized.

I suggest that the next frontier for human endeavor is to pioneer a better understanding of the nature of our social systems. The means are visible. The task will be no easier than the development of science and technology. For the next 30 years we can expect rapid advance in understanding the complex dynamics of our social systems. To do so will require research, the development of teaching methods and materials, and the creation of appropriate educational programs. The research results of today will in one or two decades find their way into the secondary schools just as concepts of basic physics moved from research to general education over the past three decades.

What we do today fundamentally affects our future two or three decades hence. If we follow intuition, the trends of the past will continue into deepening difficulty. If we set up research and educational programs, which are now possible but which have not yet been developed, we can expect a far sounder basis for action.

The Nation's Real Alternatives

The record to date implies that our people accept the future growth of United States population as preordained, beyond the purview and influence of legislative control, and as a ground rule which determines the nation's task as finding cities in which the future population can live. But I have been describing the circular processes of our social systems in which there is no unidirectional cause and effect but instead a ring of actions and consequences that close back on themselves. One could say, incompletely, that the population will grow and that cities, space, and food must be provided. But one can likewise say, also incompletely, that the provision of cities, space, and food will cause the population to grow. Population generates pressure for urban growth, but urban pressures help to limit population.

Population grows until stresses rise far enough, which is to say that the quality of life falls far enough, to stop further increase. Everything we do to reduce those pressures causes the population to rise farther and faster and hastens the day when expediencies will no longer suffice. The United States is in the position of a wild animal running from its pursuers. We still have some space, natural resources, and agricultural land left. We can avoid the question of rising population as long as we can flee into this bountiful reservoir that nature provided. But it is obvious that the reservoirs are limited. The wild animal usually flees until he is cornered, until he has no more space. Then he turns to fight, but he no longer has room to maneuver. He is less able to forestall disaster than if he had fought in the open while there was still room to yield and to dodge. The United States is running away from its long-term threats by trying to relieve social pressures as they arise. But if we persist in treating only the symptoms and not the causes, the result will be to increase the magnitude of the ultimate threat and reduce our capability to respond when we no longer have space to flee.

What does this mean? Instead of automatically accepting the need for new towns and the desirability of locating industry in rural areas, we should consider confining our cities. If it were possible to prohibit the encroachment by housing and industry onto even a single additional acre of farm and forest, the resulting social pressures would hasten the day when we stabilize population. Some European countries are closer to realizing the necessity of curtailing urban growth than are we. As I understand it, farm land surrounding Copenhagen cannot be used for either residence or industry until

the severest of pressures forces the government to rezone small additional parcels. When land is rezoned, the corresponding rise in land price is heavily taxed to remove the incentive for land speculation. The waiting time for an empty apartment in Copenhagen may be years. Such pressures certainly cause the Danes to face the population problem more squarely than do we.

Our greatest challenge now is how to handle the transition from growth into equilibrium. Our society has behind it a thousand years of tradition that has encouraged and rewarded growth. The folklore and the success stories praise growth and expansion. But that is not the path of the future. Many of the present stresses in our society are from the pressures that always accompany the conversion from growth into equilibrium.

In our studies of social systems, we have made a number of investigations of life cycles that start with growth and merge into equilibrium. There are always severe stresses in the transition. Pressures must rise far enough to suppress the forces that produced growth. Not only do we face the pressure that will stop the population growth; we also encounter pressures that will stop the rise of industrialization and standard of living. The social stresses will rise. The economic forces will be ones for which we have no precedent. The psychological forces will be beyond those for which we are prepared. Our studies of urban systems demonstrated how the pressures from shortage of land and rising unemployment accompany the usual transition from urban growth to equilibrium. But the pressures we have seen in our cities are minor compared to those which the nation is approaching. The population pressures and the economic forces in a city that was reaching equilibrium have in the past been able to escape to new land areas.

But that escape is becoming less possible. Until now we have had, in effect, an inexhaustible supply of farm land and food-growing potential. But now we are reaching the critical point where, all at the same time, population is overrunning productive land, agricultural land is almost fully employed for the first time, the rise in population is putting more demand on the food supplies, and urbanization is pushing agriculture out of the fertile areas into the marginal lands. For the first time demand is rising into a condition where supply will begin to fall while need increases. The crossover from plenty to shortage can occur abruptly.

The fiscal and monetary system of the country is a complex social-economic-financial system of the kind we have been discussing. It is clear the country is not agreed on behavior of the interactions between government policy, growth, unemployment, and inflation. An article by a writer for *Finance* magazine in July, 1970, suggests that the approach I have been discussing be applied in fiscal and monetary policy and their relationships to the economy. I estimate that such a task would be only a few times more difficult than was the investigation of urban growth and stagnation. The need to accomplish it becomes more urgent as the economy begins to move for the first time from a history of growth into the turbulent pressures that will accompany the transition from growth to one of the many possible kinds of equilibrium. We need to choose the kind of equilibrium before we arrive.

In a hierarchy of systems, there is usually a conflict between the goals of a subsystem and the welfare of the broader system. We see this in the urban system. The goal of the city is to expand and to raise its quality of life. But this increases population, industrialization, pollution, and demands on food supply. The broader social system of the country and the world requires that the goals of the urban areas be curtailed and that the pressures of such curtailment become high enough to keep the urban areas and population within the bounds that are satisfactory to the larger system of which the city is a part. If this nation chooses to continue to work for some of the traditional urban goals, and if it succeeds, as it may well do, the result will be to deepen the distress of the country as a whole and eventually to deepen the crisis in the cities themselves. We may be at the point where higher pressures in the present are necessary if insurmountable pressures are to be avoided in the future.

I have tried to give you a glimpse of the nature of multi-loop feedback systems, a class to which our social systems belong. I have attempted to indicate how these systems mislead us because our intuition and judgment have been formed to expect behavior different from that actually possessed by such systems. I believe that we are still pursuing national programs that will be at least as frustrating and futile as many of the past. But there is hope. We can now begin to understand the dynamic behavior of our social systems. Progress will be slow. There are many cross-currents in the social sciences which will cause confusion and delay. The approach that I have been describing is very different from the emphasis on data gathering and statistical analysis that occupies much of the time of social research. But there have been breakthroughs in several areas. If we proceed expeditiously but thoughtfully, there is a basis for optimism.

Suggested Readings

Jay W. Forrester, *Industrial Dynamics.* Cambridge: The M.I.T. Press, 1961.

Jay W. Forrester, *Principles of Systems.* Cambridge (238 Main St.): Wright-Allen Press, 1968.

Jay W. Forrester, *Urban Dynamics.* Cambridge: The M.I.T. Press, 1969.

Jay W. Forrester, *World Dynamics.* Cambridge: Wright-Allen Press, forthcoming.

Jay W. Forrester studied electrical engineering at the University of Nebraska and M.I.T. and made outstanding contributions to digital computer technology in the Digital Computer and Lincoln Laboratories at M.I.T. before joining the Sloan School of Management, where he has developed what has become known as "industrial dynamics." In 1968 he received the Inventor of the Year Award from George Washington University and in 1969 the Valdemar Poulsen Gold Medal from the Danish Academy of Technical Sciences. His book Industrial Dynamics *received the Academy of Management award in 1962 and his* Urban Dynamics *was chosen as best publication in 1969 by the Organization Development Council.*

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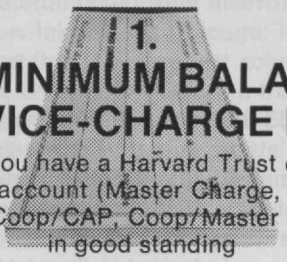

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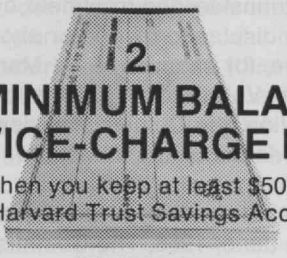

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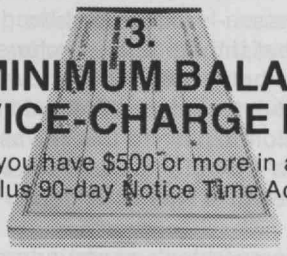

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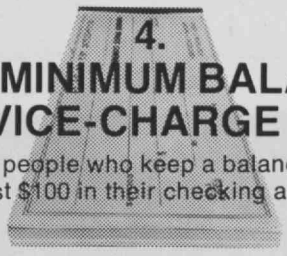

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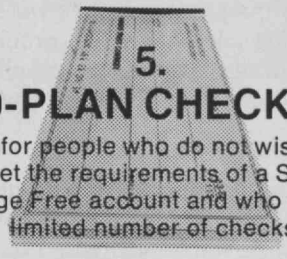

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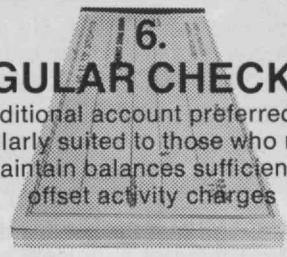

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- ☐ Harvard Trust Savings Account
  No. _____ with at least $500 balance
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Trend of Affairs

No H-Bombs for Panama

Swords, according to the prophet Isaiah, were to be beaten into plowshares, and spears into pruning hooks. The prophet Micah agreed exactly. The prophet Joel had it the other way round, with the weak saying "I am a warrior."

The biggest plowshare of them all—the Program of that name—is suffering from an unstinted application of the pruning hook. Conceived 15 years ago at California's Lawrence Radiation Laboratory, and since responsible for many subterranean nuclear detonations, the Plowshare Program is to be severely abbreviated for the second year running, so that in fiscal 1972 it may not be possible to fire a single shot—"raising doubts in some observers' minds about the future of the entire Plowshare program," according to the *Washington Post*'s Thomas O'Toole. The last Plowshare detonation was more than a year ago.

Proposed applications of nuclear explosions, investigated under the auspices of Plowshare, range from the grosser kinds of civil engineering—the blasting of crude canals, harbors, and so on—to the geological trick of opening up trapped natural-gas deposits. The latter is currently regarded as the most promising use, and the study of the nuclear-initiated Project Rulison gas-well goes on. But a plowshare is a device for cutting a furrow, and the discussions at Lawrence that inspired the Program in the first place were concerned with the digging of an alternative to the Suez Canal, which had just recently (1956) been closed. Gerald W. Johnson, manager of the Explosives Engineering Services of Gulf General Atomic, recently told how the initial call for peaceful uses for atomic bombs resulted in a wide variety of concepts, and yet "the only early major outside support for the program resulted from the interest of the Panama Canal Company and the U.S. Army Corps of Engineers in the possible excavation of a sea-level canal across the American Isthmus. It was because of this interest and its continuation that a substantial portion of the Plowshare research and development effort over the past decade has been devoted to excavation techniques." (*Science and Public Affairs,* Vol. 26, No. 6, p. 83)

Since 1965 the sea-level Panama Canal has been under intensive study; in that year President Johnson set up the five-man Atlantic-Pacific Interoceanic Canal Study Commission. In 1966, field studies in Panama and Colombia were initiated—studies which have gone so far as to consider the treatment of specific tribes who would be displaced by one or another version of the canal (see, for example, E. A. Martell's article in *Environment,* Vol. 11, No. 3). Of its total expenditures of $21.4 million, the Commission devoted $17.5 million to the nuclear-excavation question.

The Canal Study Commission was originally to have reported in June, 1968. The Commission had to decide whether a sea-level canal is needed (many economists believe that if there is a case for such a canal, it is not economic but purely military), what routes it might take, and by what techniques it should be built. In 1968 the Commission explained that it was awaiting results from the A.E.C.'s program of nuclear excavation experiments, and its deadline was extended to December 1, 1970.

As the Commission's report approached publication, the word began to circulate that the sea-level nuclear furrow was no longer to be taken seriously (for reasons mentioned in "Trend of Affairs," June 1969, p. 55—fallout and geology). The Commission thinks that a sea-level canal should be provided by the 1990's, but that nuclear explosions are not a feasible way of digging it. The dream fades. And with it, apparently, the whole beating-about of Plowshare.

Down to the Sea in Airliners

New airports are needed, within easy reach of the centers of population, but nobody wants to live near them. This typical late-twentieth-century problem, if it is ever solved at all, may be solved by one of the general-purpose late-twentieth-century solutions: take them out to sea.

At this fall's Annual and National Environmental Engineering Meeting of the American Society of Civil Engineers—billed as "Autumn in New York"—the emergence of the offshore airport was reviewed by Richard D. Harza, of Chicago's Harza Engineering Com-

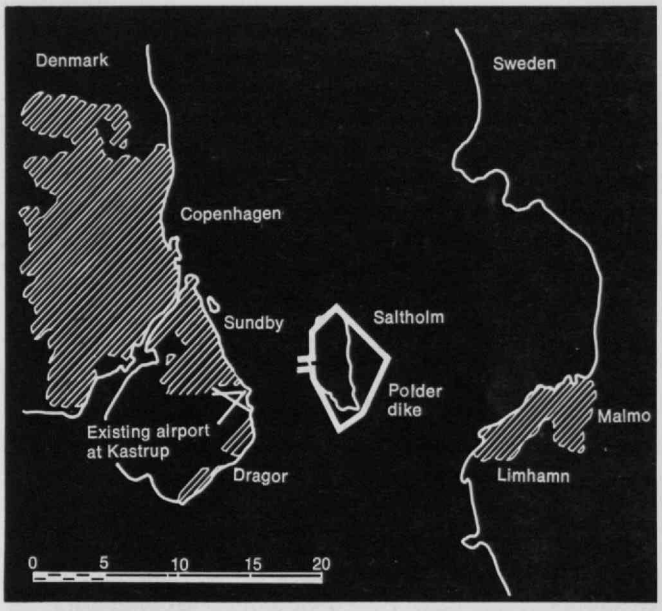
pany (which has carried out a study of a Lake Michigan Airport for that city).

Besides the Lake Michigan site, Harza listed four potential offshore airports presently under serious consideration: at New Orleans, Cleveland, Copenhagen, and London. He also mentioned one "preliminary study," the M.I.T. Class of '68 investigation of a possible Boston Harbor airport. Depending on physical and economic conditions, there are four ways of building an airstrip in a water area. The New Orleans airport, using a very shallow lake, would be built up from the lake bottom using as landfill material taken from elsewhere in the lake. Another shallow-lake site is Chicago; here, the Harza engineers decided that the cheapest solution would be a polder dam, completely separate from the shore and surrounded by a circular dike. The London airport—that city's third—would be constructed by landfill, using material dredged from the Thames's ship channels, with the reclaimed area protected from high tides by a 12-foot embankment. Copenhagen is considering the use of a polder dike around an extended version of the tidal-flat island of Saltholm, which lies in the straits between Denmark and Sweden (this airport, if built, might be combined with a road link between the two countries). The Cleveland proposal, which comes from N.A.S.A.'s locally situated Lewis Research Center, is a landfill scheme which aims at creating an initial 1,050 acres, a mile offshore in Lake Erie.

As examples of existing offshore airports—marginal, rather than completely separate from the mainland—Mr. Harza cited Genoa's Cristoforo Colombo Airport, built between 1955 and 1962 when land near Genoa cost $450,000 an acre, against $61,000 for an acre of reclamation, and the jet runway of Papeete-Faaa, Tahiti, where there was simply no more flat land on the island.

Of the five proposals cited, none has yet been approved, but if London's third ever materializes it seems likely to be at the offshore location, to judge by the obduracy of the inhabitants of the proposed land sites. Mr. Harza sees no really forbidding new problems in the water, and it must be admitted that the problems of the land airport grow more so year by year.

Denmark is considering creating land for a new airport by extending the tidal-flat island of Saltholm with a dike—one of the more unusual offshore airport concepts currently under study. Distances shown are in kilometers.



After the War Is Over

There are plenty of photographs that show quite clearly what's been done. The ground in one is all barren, eroded brown and gray, with just a patch or two of green. Only two plants live, low ones. Or the whitened skeletons of every hardwood tree that lived are each singly clear, and through them the new green of the invading bamboo. Or the ground is utterly stripped and hard, the dead trees cut for firewood. Vietnam, "defoliated."

Not all of Vietnam, just an area the size of Massachusetts; and not all of that killed. But no one here or there knows how much damage has been done, how long the land will need to recover, how long before the forests grow again. Feeling that someone ought to know, the American Association for the Advancement of Science sent Matthew Meselson, Professor of Biology at Harvard; Arthur Weston, a forester from Windham College; Robert Cook, a graduate student at Yale; and John Constable, Professor of Surgery at Harvard Medical School, to Vietnam last August to prepare a plan for comprehensive study. The four, with a group of Vietnamese scientists, spent four weeks looking at defoliated areas, talking to farmers, and taking samples of soil, plants, fish, human hair and milk, and the like. They are making their report and releasing their photographs at the A.A.A.S. meeting this December.

Unfortunately, it is hard to correlate the damage that they found and saw with the time and intensity of spraying missions, because the flight records were not open to them. Why the classified records were not made available is a matter of dispute. *Science (Vol. 170, pp. 42-45)* quotes a Pentagon official as describing Dr. Meselson as "naive" and "impatient" and as having "run off to Vietnam to conduct his study before he had ironed out all the arrangements." *Science* adds that Lee A. Dubridge "told A.A.A.S. that Meselson had either misunderstood or ignored the information given to him by the Defense Department prior to his departure for Vietnam," and that the Pentagon and the Pacific Command each identified the other as the bottleneck.

In an interview with *Technology Review,* Dr. Meselson

said that he had requested access to data months before the trip, but that D.O.D. had just not wanted it declassified, even though that move bore the recommendation of Ambassador Ellsworth Bunker. Information on recent and current flights was freely given, he said, which would have much greater value as a military secret than that on past flights.

What the group did see corroborates the reports of previous visits by Fred Tschirley of the Agricultural Research Service of the U.S.D.A. and by E. W. Pfeiffer of the University of Montana and Gordon Orians of the University of Washington. The riverside mangrove complexes, which shelter shellfish, an important food, are usually destroyed by one spraying. The hardwood forests can survive one spraying if it is not soon followed by another—and often two or more are given. Then the dead trees leave the land to bamboo, which is nearly ineradicable when established. Rubber plantations are affected—as much as a 30 per cent loss was sustained in one year, Dr. Orian and Dr. Pfeiffer said.

Food crops, especially rice, are also sprayed to deprive the enemy of his supply. (Mr. Ngo Cong Duc, secretary-general of the Socialist Opposition in the National Assembly, writes in the *New York Review* [November 5, 1970] that South Vietnam, once "rich in rice, . . . is now reduced to consuming American rice.") Dr. Meselson reported that his group observed the spraying of rice fields which were thought to be feeding the Viet Cong. The group visited the land a few days later to find its Montagnard owners leaving because of the "evident pestilence" which had fallen on it *(Nature, Vol. 228, pp. 108-109)*.

Dr. Meselson returned to the U.S. before the report came from Ronald Ridenhour (who wrote the letters that started the My Lai investigation) that he had slipped his army escort during his recent visit long enough to find that the Americal Division was still spraying Agent Orange. Orange—mostly 2,4,5-T—was announced last spring to have been discontinued from use in Vietnam, and in populated areas in the U.S., after a few studies suggested that it, or its contaminant dioxin, causes serious birth defects.

Dr. Meselson said, in the interview, that he had tried to obtain samples of Orange in Vietnam for analysis, only to be told by the commissioner of the chemical staff in that country, a colonel, that all of it was under lock and key. He had not been in Americal country, but in the III corps area to the south, the stuff was plainly not under particularly rigorous security. Each corps general is "like a king" in his own area, he said, and is not really answerable to General Creighton Abrams, who, with Mr. Bunker, approves each spraying mission.

S.S.T. and Concorde --Unusable?

Even if the Senate had not cut the S.S.T. appropriation, the chances are good that the Magnuson restrictions on its flight would have made it an impossible aircraft. The Magnuson bill requires that the supersonic transport meet F.A.A. noise standards for subsonic planes—108 EPNdB at 0.35 nautical miles (2130 feet)—for take-offs.

Laurence I. Moss, of the National Academy of Engineers (see below) told *Technology Review* that the S.S.T. engine can probably not be built to be that quiet. "It is qualitatively more difficult to reduce noise on the S.S.T.'s type of engine (a high temperature, high velocity turbojet) than on a typical subsonic airplane engine (a high bypass-ratio turbofan)," he said. "And the S.S.T.'s payload, a per cent of gross weight, is much smaller than the 747's, so that extra weight associated with noise suppression equipment has a relatively high economic penalty."

Mr. Moss suspects that Boeing and General Electric might well have declined to go ahead under the new bill.

The Concorde, if the F.A.A. requirements were applied to it at U.S. airports, would also be illegal. Mr. Moss explained that its engine produces more noise on landing than the American S.S.T.'s. The noise spread to the sides on takeoff is slightly less, but the noise in the direction of flight is greater. "If the Concorde is banned from U.S. airports for its noise problems," he said, "it will not be important to commercial aviation."

Plain Dreams

A petition presented to seven airport administrations by the Environmental Defense Fund, Inc., shows, using Department of Transportation data, that the noise from the S.S.T. will make most of the cities around the airports unusable for living, in any acceptable sense of the word, and further, that a lot of the people thus discomfited can be expected to sue.

The data on S.S.T. noise was developed by Laurence I. Moss, Executive Secretary of the Committee on Public Engineering Policy of the National Academy of Engineering. Speaking in a private capacity, he described the noise profiles that the S.S.T. will make: the N.E. (a noise exposure index compiled from the number of take-offs per day, the time of day, and the perceived-

noise intensity of each take-off) would reach at least 30 in large parts or all of the cities which the airports served. Above N.E.30, D.O.T. says that ". . . individuals may complain, perhaps vigorously. Concerted group action is possible." The building of new, single-family dwellings is *not* recommended in areas above N.E.30.

The N.E.30-or-above regions are roughly circles: the radius for J.F.K. is 26.5 mi.; for San Francisco and Los Angeles, 11.4 mi.; for Seattle, 8.5 mi.; for Boston, 7.6 mi.; for Honolulu, 20.8 mi.; and for Anchorage, 13.3 mi. (in flat areas; hills are more complex). Thus, for most of the areas of these cities, the noise would be above that recognized as tolerable to residential areas. A 747 profile at N.E.30 for J.F.K. reaches only 1.1 mi.

S.S.T. proponents have claimed that, because the noise is intensive for a shorter time in the direction of flight, it will be less bothersome than the take-offs of subsonic jets now in use, although sideline noise will be greater. The S.S.T. profile is rather a tangerine than a straight banana. (Robert Cannon, Assistant Secretary for Systems Development in D.O.T., speaking at M.I.T. this fall, admitted that the S.S.T. will make about seven times as much noise as a 747; but, he said, that won't be such a bad noise.)

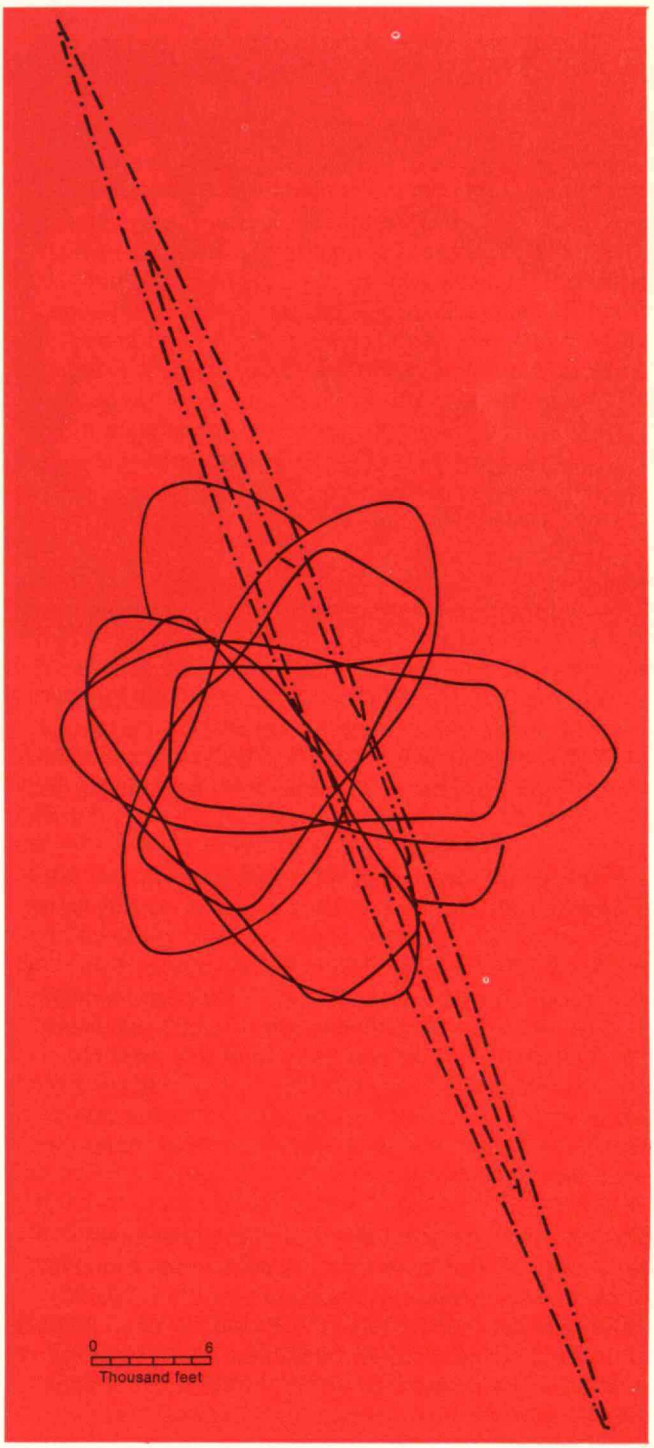
Mr. Moss points out that, in making its predictions, D.O.T. is apparently using figures for what it hopes S.S.T. noise levels will be—112 EPNdB at 2,130 ft., above the December, 1969, F.A.A. requirement for subsonic jets—not for what seems likely—124(±5) EPNdB, by D.O.T.'s own data. Short of cutting payload or using less thrust for a longer take-off, there is no way of getting the S.S.T. down to the desired figures, he says; further, even the 747, used by Mr. Cannon in his comparison, does not meet aviation noise standards current or future lower.

Mr. Moss adds that "the F.A.A. has made it abundantly clear, in repeated statements, . . . that it will not set noise standards which are beyond the ability of a given type of airplane to meet." Since the F.A.A. cannot be expected to impose standards which will not "sacrifice" the "peace and quiet" of the people who live within the circles Mr. Moss describes, the Environmental Defense Fund is petitioning the seven airports to act themselves to set standards for their own facilities.

The precedent exists, in Supreme and lower court decisions, to sue for interfering "with the use and enjoyment of private land as to constitute a Fifth Amendment 'taking' for which just compensation would have to be paid" *(United States v. Causby). Griggs v. Allegheny County* extended the liability to the operators of the airports. While these cases deal with overflights, further precedent can be shown for damages to result from simply the noise and vibrations (and possibly the pollution) resulting in "oppressive environmental impacts."

In the face of the common argument that the Russians and the French will steal the S.S.T. market if we don't build our own, one can realistically argue that it might just be more expensive to fly it than to forget it.

Comparative noise profiles of the 707 (long and narrow area) and the S.S.T. over O'Hare International Airport. Within these areas noise would measure 108 EPNdB or greater. However, the noise perpendicular to the flight direction (sideline noise) from the S.S.T. is a more serious problem. In a petition presented to the administration of O'Hare and six other airports, Laurence I. Moss, of the National Academy of Engineers, noted that the sideline noise, "implied by S.S.T. proponents to be an airport, not a community, problem, will be highly objectionable at distances of over 15 miles from an airport intensively used by the S.S.T. and over 9 miles from an airport with intermediate use." (Chart: Aviation Week and Space Technology*)*



Wanted: a Miner's Canary for the World

When members of the Study of Critical Environmental Problems finished identifying the processes through which man may be affecting the earth on a global scale *(see* Technology Review *for October/November, pp. 58-59),* they asked George D. Robinson, of the Center for the Environment and Man, Inc., of Hartford, Conn., and his colleagues how far man has progressed down the path of change. The answer: "For every one of the global problems that have been identified, we have insufficient knowledge of either the workings or the present state of the environmental system."

But filling at least some of these gaps may be less difficult and expensive than one might expect.

For example, what about all the CO_2 that results from our accelerating use of long-stored fossil fuels? Some of it appears to remain in the atmosphere. But the atmosphere may also be the route to more permanent storage in oceans and plants. To answer the question—which carries with it an answer to the possibility of inadvertent climatic change—would require a world-wide capital investment of less than $3 million and annual operating costs of $2.5 million to supplement existing research stations and their programs. For that outlay, said Dr. Robinson's group, we could accumulate those data which we now know how to use on world CO_2 storage in plants, its routes in the atmosphere, and its storage and release in the oceans.

The measurements would be in no sense direct. Oceanic CO_2 content depends on temperature, and so among the proposals are more complete data on sub-surface temperatures. The rate at which the ocean can absorb atmospheric CO_2 depends on the rate at which surface water sinks into the cold depths, where CO_2 storage is very high. To learn that, measure the C-14 accumulated in the depths from past nuclear tests—now, and for the next ten years.

As to measuring other man-made environmental changes, the S.C.E.P. monitoring group is equally optimistic. World-wide studies of particulates, made by measuring solar radiation and the intensity of light returned to the earth from the sky, would be inexpensive. For less than $1 million worth of photometer and solar radiation installations integrated into existing meteorological networks, and with annual operating outlays of just over half that, we could resolve our doubts about the changes in the amounts of inorganic atmospheric pollutants.

To study atmospheric sulfate and nitrate particles adequately, Dr. Robinson and his colleagues propose sampling and measuring equipment worth $700,000, with annual operating costs at 100 stations of $5 million. The same stations, with an additional $250,000 worth of sampling and analysis equipment, could provide adequate data on nitrogen oxides in the atmosphere; $100,000 would equip the same stations for SO_2.

Add to these figures the modest cost of including in on-going research programs a world-wide survey for pollutants of fish, plankton, mollusks, and crustacea from the world oceans, of examining surface and bottom water and bottom samples from 19 river systems, and ice samples from various depths in six glaciers; and the cost of occasional world-wide rainfall samples—in all, a 1,000-sample survey of continental waters analyzed for a broad spectrum of contaminants.

Add, also, a program of stratospheric monitoring—simply adding equipment, perhaps a total of $10,000—to aircraft already flying.

By most standards these total costs must be seen as modest. But they may, says Dr. Robinson, be the modern world's equivalent of the miner's canary.

Recycle or Bust

"Out of the 36 most important industrial raw materials consumed by our manufacturing industries, the U.S. is self-sufficient in only 10 . . . and must import all or part of the remaining 26. The Soviet Union, on the other hand, is self-sufficient in 29 and needs to import only 7 of these materials," wrote Dr. Raymond Ewell, Vice-President for Research at the State University of New York, in a recent *Chemical and Engineering News* feature.

While we could undergo a considerable decline in our material standard of living and still survive, the competition for world leadership between the U.S. and the U.S.S.R. puts an entirely different light on this picture, he thinks. Though Dr. Ewell's political deductions may be debatable, his natural-resource comparisons between the two countries are worth noting.

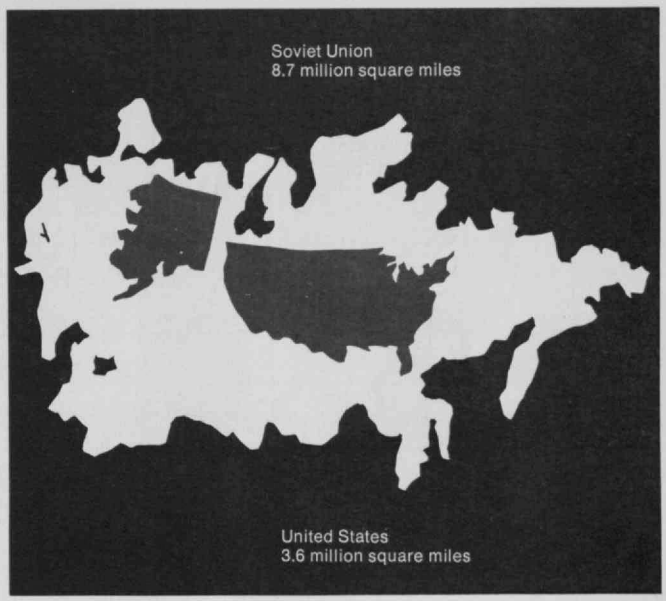
When the last frontiers of the U.S. were disappearing early in this century, the Soviet Union with its vast unexplored terrain was just emerging as a nation. The U.S. was already industrialized while the Soviet Union was an agrarian country debilitated by the effects of both a world war and a civil one. Since then, the U.S. has produced vast volumes of consumer goods; the Soviet Union has concentrated single-mindedly on heavy industry and capital goods. The result, as Dr. Ewell points out, is that while we have rapidly been depleting our resources, the Soviet Union still possesses vast unused potential. Dr. Ewell believes that by 1980 the Soviet Union will be substantially ahead of the U.S. in the production of steel, cement, and coal, and about even in petroleum. By 2000, Soviet superiority in domestic raw materials will become overwhelming. Dr. Ewell fears that once the Soviet Union believes it is beginning to pull ahead of the U.S. in "basic industrial power," then "believing that military and political power follow industrial power, it may begin to put political pressure on suppliers of raw materials to reduce or stop shipment to the U.S. and/or raise prices of raw materials to us and our allies."

So, Dr. Ewell says, we should be nicer to nearly everyone—particularly to Canada but also to South America

and other areas which are ready sources of industrial raw materials. He points out that our deficiency in raw materials compared to the Soviet Union is, in 1970, more than compensated by "our superior technology in nearly every industry; better research and development —the source of our superior technology; more productive labor and more efficient organization and management in industry." But he also suggests that we find methods of using lower grades of minerals, more sophisticated techniques of discovery for North American sources of minerals, and finally, better methods to recycle all nondegradable materials.

It is in this last respect that we may well need to make the most strenuous efforts. For while the proximity of the natural wealth of Canada and South America are comforting, this wealth is not ours. Since our neighbors are under no obligation to hand it over to us, we could find ourselves compelled to get along with what we have—recycle, or else.

Though the United States' supply of industrial raw materials seems vast, she has been consuming them at a high rate for a long time. Far longer than the U.S.S.R., which has a land mass greater than that of the U.S., Canada, and Mexico combined and undeveloped forest and mineral reserves. How will America need to rethink its consumption habits in order to compete successfully for international economic dominance?



Slow Progress on Snail-Borne Ills

The major illnesses of the world are not cancer and heart disease, as in the U.S., but malaria, tuberculosis—both still thriving—and schistosomiasis. The latter, a near relative to malaria and second only to it as a worldwide killer, affects at least 200 million people, establishing a vicious poverty cycle in tropical and subtropical areas. Infected people are too debilitated to produce at more than the subsistence level which leaves them most vulnerable to the disease. Progressive schemes involving new irrigation tend to *increase* the disease levels. Research announcements made in recent months give some idea of the task that still remains.

Schistosomiasis is the infestation of the liver by an inch-long worm. The liver, functionally damaged, swells and presses on other organs, making breathing difficult, while the blood flow becomes restricted. The sufferer is rendered more prone to jaundice, anemia, and liver cancer, in addition to his chance of dying of the original disease.

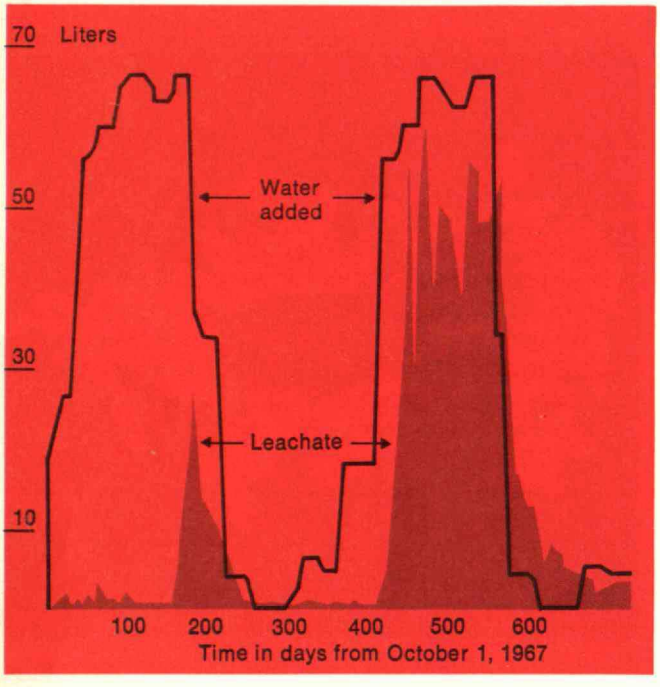
The parasite has a two-stage life cycle: one stage in a mammal, the other in a snail. The snail excretes a free-swimming form of the worm which lives 24 hours. If, during that time, it encounters a warm-blooded host, it enters the skin and drifts along the bloodstream to the liver. To mate, the full-grown worm migrates to the intestine or gall bladder, whence another young form is excreted, frequently back into the habitat of the snail.

Omnipresent in most of South and Central America, Africa, China, and Egypt (where it has been greatly boosted by recent water-management programs), the parasite cannot yet be controlled by any known method. The primary target of most research is prevention rather than cure, for "cure" would consist in removing the parasite—a difficult goal, in view of the weakened condition of the patient. Besides, the disease is likely to be picked up again almost immediately.

To eliminate the parasite from the environment one link in its life cycle must be broken. One approach aims at killing the snails: not easy, without killing fish and shellfish which are needed as food. But Dr. Howard Bond, of the University of Rhode Island, this fall reported to the American Chemical Society's Northeast Regional Meeting that two compounds were worth testing in the field—zinc dimethyldithiocarbamate, a commercial fungicide, and divinyl sulfone. The former is effective against the snails but apparently not very toxic to fish. (To shellfish, though, it may be.) Of divinyl sulfone, less is known, but it too is effective against *Biomphalaria glabrata,* the water snail which carries the parasite in the Western Hemisphere. The snail which does the same job in Africa would probably be susceptible likewise; but the oriental version of the disease is carried by an amphibious snail, able to escape from any water treatment.

Nathan F. Cardarelli of the Creative Biology Laboratory of the University of Akron believes that "killing all the snails" is not only impracticable but, as an objective, misguided. The parasite, not the snail (or man, for that matter), is the offender, and Dr. Cardarelli seeks a way

There is considerable time lag between the addition of water to a sanitary landfill, as measured in a laboratory simulation, and the generation of pollutant-bearing leachate. Some leachate appeared within a week of the initiation of the test on dry soil, but most occurred only after both soil and refuse had attained their respective maximum moisture content. Water was added according to calculations of natural seasonal availability.



of eradicating the worm with as little disturbance as possible to other living things.

His team have found that the free-floating forms which it adopts on its way between hosts are destroyed by a poison known as B.T.B.O.—bis(tri-n-butyltin oxide)—in concentrations low enough to leave plants, fish, and shellfish unharmed. Previous work on this substance as a slow-release marine antifouling compound has shown that single applications can be effective for years. The suggestion is that B.T.B.O. would be used in the form of pellets which would release the poison slowly, keeping the aqueous concentration at the needed level for a long period, and thus slowly eradicating the floating parasites without harming other creatures. Again, the oriental form would be the exception—it can be transmitted while out of the water.

Dr. Bond notes that in most of Southeast Asia, where schistosomiasis has not taken hold (except in the Mekong Delta of Vietnam), the soil contains a relatively high concentration of copper, to which the snails are acutely sensitive. The United States is free so far, but Dr. Bond feels that if the disease were brought here it might well find our watery areas a good breeding ground.

Tuberculosis, he adds, is increasing here, as well as in the rest of the world. And malaria, a continuing problem in many countries, is also infecting more people because of resistant varieties of the carrier mosquitoes, more irrigation, and less use of pesticides. Comparing statistics, he points out that malaria, T.B. and schistosomiasis account for perhaps 75 per cent of the world's illness; cancer and heart disease for less than 10 per cent. Research on schistosomiasis, he concludes, is "undersupported."

Landfill as Polluter

Don't take solid waste disposal in a sanitary landfill for granted: it is not so sanitary after all, in spite of being recommended by the Bureau of Solid Waste Management. For evidence, study the highly polluted water which is probably draining from it.

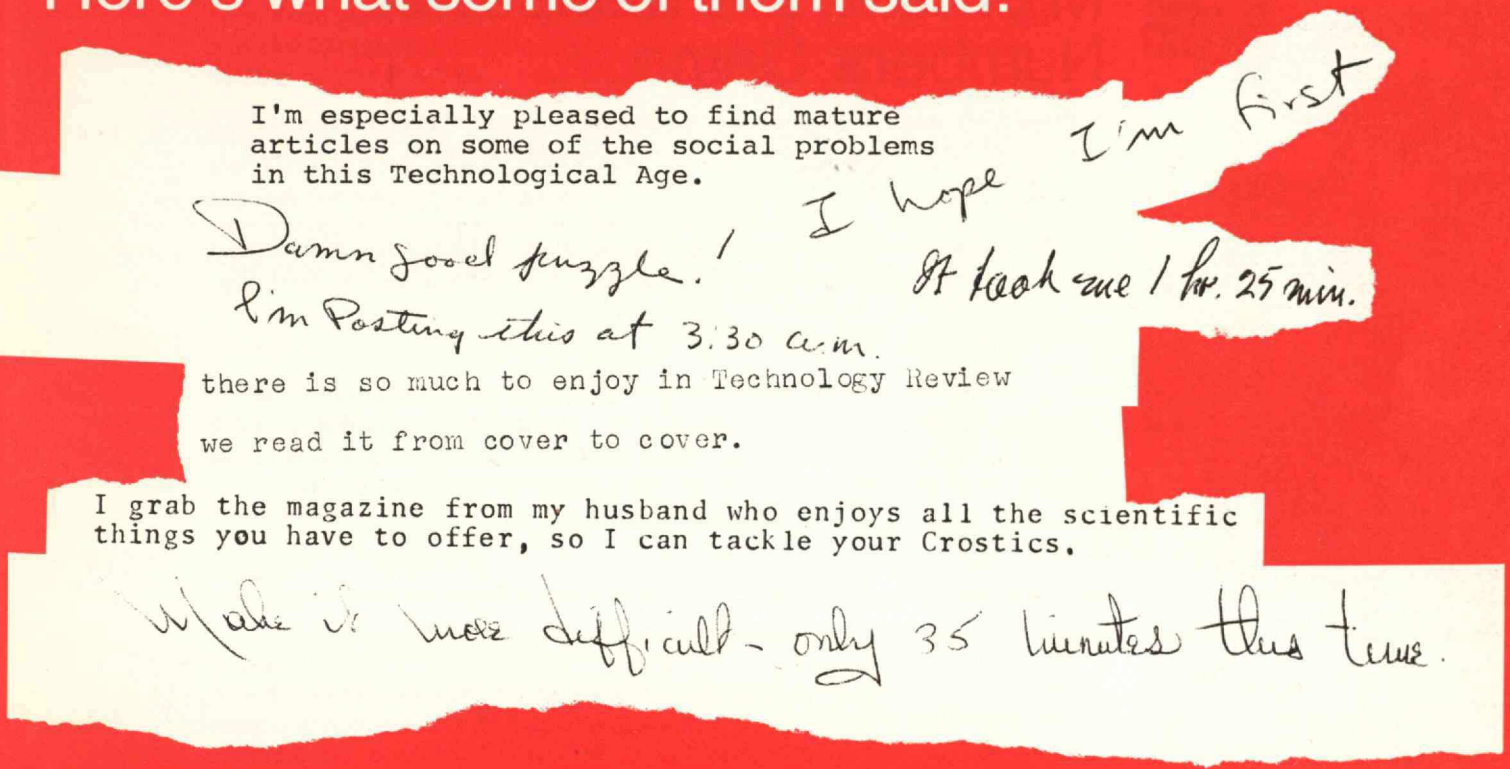
Water is one of the products of the degradation which occurs in any landfill of typical domestic solid waste; but the far larger sources of drainage are the rainfall on the landfill surface and springs or streams buried within the landfill volume. This landfill contains the leached-out products of an irregular process of decomposition.

Reporting to the National Industrial Solid Wastes Management Conference in 1970, A. A. Fungaroli of Drexel University described his analysis of the leachate from a 21-year-old landfill inactive for less than a year: chemical oxygen demand of 21,120 mg./l., (compared with 211.0 mg./l. in a nearby stream); sodium, 1,100 (100); free chloride 1,600 (193); sulfate, 790 (65); nitrate, 196 (9). Biological oxygen demand figures are suspect because of the high concentrations of heavy metals present.

Dr. Fungaroli and his colleague, Robert J. Schoenberger, advised the Conference that "a sanitary landfill is actually an in-place treatment system, not only a method of disposal." But unfortunately, they continued, "the landfill degradation mechanism is highly inefficient. . . . No studies of consequence have been performed to show whether or not there are present the necessary concentrations of metals and nutrients for optimum decomposition of solid waste."

To make possible such studies, Dr. Fungaroli and his colleagues in the Advanced Study Group for Soil, Water, and Urban Engineering at Drexel have now created in their laboratory a simulated sanitary landfill. Having laid down a layer of refuse eight feet thick with a two-foot soil cover, they are now varying the temperature and moisture supply to determine the amount and content of the leachate and comparing their data with that from several landfill sites in the East. "Only when we have a genuine understanding of sanitary landfill behavior," writes Dr. Fungaroli, "will we be able to properly utilize and control sanitary landfills for disposal and, at the same time, fulfill our obligation to future generations."

When we asked Technology Review readers to compete for prizes in solving the October/ November Tech-Crostic, over 130 rushed to the nearest post office with their answers. Some stayed up all night; some spent 35 minutes. Here's what some of them said:



I'm especially pleased to find mature articles on some of the social problems in this Technological Age.

I'm first

I hope

Damn good puzzle!

It took me 1 hr. 25 min.

I'm Posting this at 3:30 a.m.

there is so much to enjoy in Technology Review

we read it from cover to cover.

I grab the magazine from my husband who enjoys all the scientific things you have to offer, so I can tackle your Crostics.

Make it more difficult - only 35 minutes this time.

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Cambridge Journal

What will the engineering job market of the future look like, given recent aerospace cutbacks and the general economic climate? Increasing numbers of engineering students across the country are worried whether they will be able to use their training in a good job. But until this year, at least, M.I.T. has escaped the employment—or rather the unemployment—pinch. (Photo: Ivan Massar, Black Star).

M.I.T. and the Manpower Numbers Game

Is there a shortage of engineers and scientists? Or too many? What about the future? How many professionals should we be educating, and in which fields? Does *anybody* know?

Whatever the answers, on Route 128—Boston's belt of high-technology industries—over 10,000 scientists and engineers are unemployed thanks to the general economic slowdown in their specialties.

As of July, 1970, the Deutsch, Shea and Evans, Inc., Engineer/Scientist Index, a national measure of the demand for these professionals based on advertising, was at an all-time low. And D.S.&E. foresaw "no substantial change in the technical manpower picture in the immediate future." The D.S.&E. Index rose a bit in August, but the analysts insisted this fall that "even if the downtrend in employment is ending, a demand plateau near the current level is a likely prospect for the next few months."

The Engineering Manpower Commission's 1970 survey shows that the demand for engineers has slowed from 6 to 7 per cent a year (1964 to 1966) to 2 to 3 per cent (1969). Employment in one field is absolutely down, employment in most fields was only slightly increased, and modest increases are expected to 1975.

M.I.T. has only begun to feel this overall market crunch this winter. As of the summer, when the Class of 1970 were seeking jobs, Robert K. Weatherall, Director of Placement, said that "very few cases came to light (among 1969-70 graduates) of genuine unemployment." Fewer graduates may have been offered the one job they really wanted—and most probably had fewer offers from which to choose. "But very few students seem to have taken jobs that were distinctly second best," Mr. Weatherall observes. "The intellectual quality of M.I.T. students appears to have held doors open to them."

The facts are that representatives of 65 companies cancelled visits to M.I.T.'s Placement Office to interview students during 1969-70, and those who did in fact come made fewer offers than in previous years. Bell Telephone Laboratories, Inc., for example, which hired 33 M.I.T. graduates in 1968-69, took only 23 in 1969-70; and this fall Bell Labs did not recruit on the campus at all.

Physics is a good example of a field in which M.I.T. has been holding its own in the national job mart. The Institute produces only 2 per cent of the nation's physicists, but in 1969-70 they distributed themselves "normally"—that is, like the previous year—with 24 of the 51 who received Ph.D. degrees in June continuing their academic research at M.I.T. or elsewhere. Only seven more took jobs in industry in 1969-70 than in 1968-69.

M.I.T. graduated 20 doctorates in aeronautics and astronautics in 1969-70, compared with 11 in the previous year. Eight of this year's group opted for academic careers; last year, more went into government and industry. In electrical engineering, the Class of 1970 (139 students) distributed itself on the job market much the way the Class of 1969 did (167 students). Last year 70 went on to graduate work; this year 52 did. Last year industry hired 44 of them, this year 42.

But although M.I.T. could still be comfortable this summer—despite the economy—this fall it is less so. Whereas 184 companies recruited at M.I.T. in the fall of 1969, only 135 came through December, 1970. Those who came are sending fewer interviewers for fewer job openings.

M.I.T. has felt the national job pinch most severely in alumni placement. There is a kind of "mismatch" going on, says Mr. Weatherall. Companies are submitting job descriptions which M.I.T. can't fill, while alumni with different qualifications are applying to the Alumni Placement Office in record numbers. From June through November, 1969, that office advertised 3,171 jobs and saw 274 applicants. In the same period of 1970 it advertised half the number of jobs (1,677) and interviewed double (492) the number of men!

What of the future? In a report prepared this fall, Raymond L. Bisplinghoff, then Dean of Engineering at M.I.T., and John A. Currie, Assistant Dean, insist that "an engineering manpower gap" is developing in the U.S. "The best available estimates show that there will be something like 65,000 job openings for engineers of all kinds each year during the first half of the 1970's." Current annual production of engineers is about 40,000, they write. But if present school enrollment trends continue, American engineering schools will in fact, in 1975, graduate fewer engineers than they did in 1969.

Blacks, Polaroid, and Apartheid

Recent events at the Polaroid Corporation leave no doubt that the ideas and tactics of the "revolution" which has swept American campuses in recent years are now entering the American corporation. And they may in fact surface at the more "liberal," "humanist" corporations first.

At issue in this case is whether Polaroid should continue business in South Africa through a company there, Frank and Hirsch, (Pty.) Ltd. Polaroid reports annual sales of $1.5 million (these are small, by Polaroid international standards) in South Africa by Frank and Hirsch through two product lines. One is a film-and-identification system, ID-2, alleged to be used for passbooks to enforce the South African government policy of apartheid; the other is a line of sun glasses which are assembled from Polaroid lenses manufactured in Massachusetts in an operation employing 200 blacks. The question here is whether this employment is fairly paid by American standards or whether the blacks are treated like "slaves," as it is alleged they are in other businesses in that country.

A proclamation pinned to Polaroid's Cambridge headquarters bulletin board October 5 announced the existence of the Polaroid Workers Revolutionary Committee (P.W.R.C.) and called attention to the South African activities of the company. Two days later, outside the Polaroid office building, one of the two identifiable members of P.W.R.C., Kenneth Williams, led a rally. Mr. Williams is one of many blacks hired by Polaroid, which has an aggressive minority recruiting plan; he began work as a custodian; in 1968 the company published a book of his photographic work; now he has resigned over the South Africa issue.

Management admits it has been caught in a "crisis of conscience." The company has a long, nationally distinguished record of hiring, training, and promoting American blacks. This year, in addition to donating to the United Fund, Polaroid put money into the United Black Appeal. In Boston,

Polaroid Corp., an international firm with a long record of hiring and training blacks, has been under attack from its own employees for doing business in South Africa. Polaroid spokesmen predict (see right) *that other U.S. companies doing business in South Africa will not remain immune to similar pressures. (Photo: Don Estes)*

Polaroid operates a wholly owned subsidiary, Inner City, which has the highest retention rate (82 per cent) for any black training program known. To date, Inner City has retrained and aided 125 blacks who are now employed at Polaroid.

Polaroid executives, including Edwin H. Land, the President who is the company's founding genius, said to the *Boston Globe* in November that before the P.W.R.C. proclamation and rally they were unaware of the uses to which their products are put in South Africa. But Dr. Land told the *Globe* that in 1948, the then small company had a chance to mushroom through signing a contract with the South African government. The company declined on grounds of morality, he said. And *Globe* writer Donald White, to whom Polaroid opened its doors when the crisis erupted, wrote, "There seems all along to have been a subconscious effort to keep the lid on South African business, yet the company became mousetrapped nonetheless."

Robert Palmer, Manager of Community Services at Polaroid, agrees with other management spokesmen in favoring, in conscience, a full company pullout. But "my worry is that if everybody withdraws from South Africa, will it cause more repression? Is it going to cost jobs? Is it in fact going to enforce the policy of apartheid? Will we be more effective if we stay there in some form and positively make an effort on a policy we don't like?"

Polaroid has decided to "discontinue sale on any Polaroid products, including film, directly or indirectly, which might be used in the (apartheid passbook) identification program." But there remains the question of continuing other trade with South Africa, which is now being studied by an ad hoc committee of employees and management, black and white. Two sales personnel are in South Africa now, and the company has sent a task force of two blacks and two whites to inspect the situation there. But this idea has met two kinds of obstacles: concern about whether Polaroid can insure freedom and mobility to the task force blacks while they are in that country, and, on the other hand, criticism that such a trip is "sleight-of-hand" and unnecessary—that the moral facts need no more research.

No one at Polaroid believes that the other 300-odd U.S. companies who now do business with South Africa will remain immune from similar pressures. "Industry had better sit up and take notice," Mr. Palmer told *Technology Review*. "The national issue of involvement participation and control is very real to all of us, not just to the campus or school."

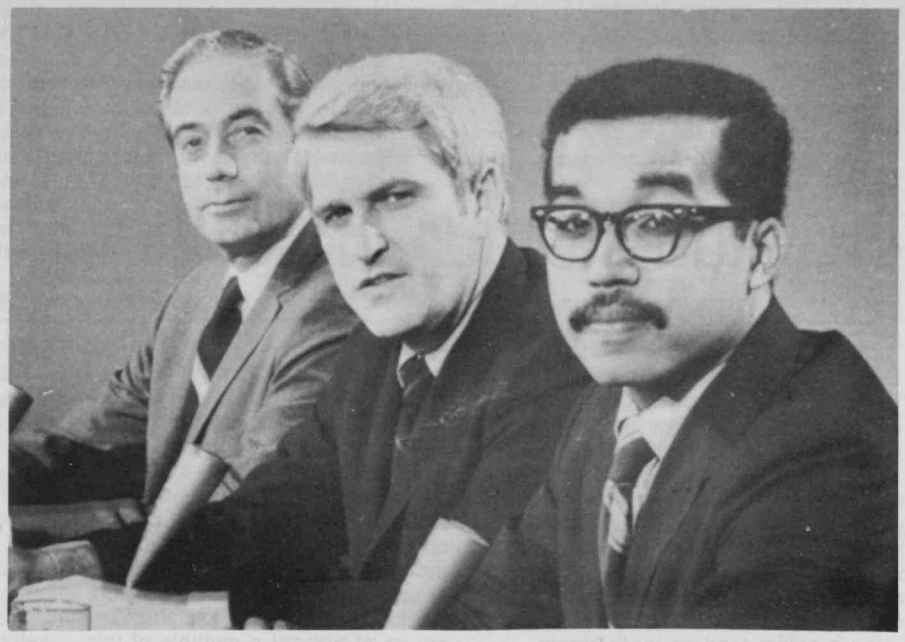
And even the soul searching of a company as "progressive" as Polaroid sounds ominous. Mr. Palmer says, "I think Polaroid is doing a lot of things well, but it has made a lot of mistakes. We've done a good job in hiring but we've got a problem in upward mobility. All companies have that—the problem is to get us to deal responsibly with it."

"We Walked in Black Men's Shoes"

"When we started in, I never thought all nine members would sign a majority report," said James Ahern of the President's Commission on Campus Unrest at a seminar at M.I.T. this fall.

But it finally happened, and the change came when the Commission went to hearings in Jackson, Miss. "No one could ignore an atmosphere charged with racism," said Mr. Ahern. "We walked a mile in a black man's shoes."

What did the Scranton Commission really learn about campus unrest? A great deal, said Mr. Ahern, who is Chief of Police in New Haven, Conn., and Joseph Rhodes, a Junior Fellow at Harvard who was the only student member of the Scranton Commission. The Commission learned about racial conflict in law enforcement (as at Jackson State College and Lawrence, Kans.), university governance, and community-college relations. They learned



James Ahern, New Haven Chief of Police and a member of the President's Commission on Campus Unrest, talked to many other policemen during the Commission's investigation, including those involved in the shooting of four students at Kent State University last May. Despite the political reception given to parts of the Commission's report last fall, Chief Ahern predicts that the section on law enforcement will have an enormous, long-term impact on police reform and the handling of future campus disorders. He is shown here with William Scranton and Joseph Rhodes, Jr. on Meet the Press *last fall. (Photo: Wide World).*

about young people's growing cynicism, that students and authority simply lack a common definition of reality.

Not only "students" and "authority," cautioned Dr. Benson R. Snyder, Dean for Institute Relations at M.I.T., who was a member with Mr. Ahern and Mr. Rhodes of the M.I.T. seminar this fall. The real difference is in the way people see the world, not who they happen to be, or how old.

For example, said Mr. Ahern, on the basis of Commission hearings on reports of the Federal Bureau of Investigation—and despite the later Grand Jury findings—the firing by National Guardsmen at Kent State was "unwarranted, unjustified, and inexcusable." He believes the Scranton Commission's findings on law enforcement will, in fact, have great impact on police reform and on their handling of future campus disorders.

What sort of new reality do students seek? Mr. Rhodes expressed it this way: "Advanced cultures are due for changes which will upset a lot of people. Our hope is for a slightly more humane, slightly more socialistic state. But it's not appropriate to talk about even these goals in terms other than struggle."

Mr. Rhodes admitted—with regret—that students are often "disrespectful and snobbish." But Mr. Ahern said the Ohio National Guard were "defensive to the point of being uncooperative" to Commission investigators. Nevertheless, said Mr. Rhodes, students need to develop better tactics, to learn how to sustain themselves through disappointment and to rid their ranks of introversion and irresponsibility—especially of the bombers. "They're ripping the movement apart," he said, "and only we can stop them. Or soon we'll all be butchers—some of us talking revolution, some reaction."

What about the current state of the student movement? Washington first really felt its influence only six months ago, said Mr. Ahern, when President Nixon sent U.S. troops into Cambodia. But now the campus mood is strangely quiet—and yet more tense than before. Is it quiet because of apathy, or because students are discouraged over their apparent ineffectiveness, or because of fear of repression? Impossible to tell.

The Commission report has now become a political document, used to divert attention from the basic problems it tried to define. But Mr. Rhodes thinks the Commission "lost a narrow chance" to recommend certain kinds of structural changes in a reasoned, carefully documented way to the highest levels of power. Is he bitter? No; bad as things are, they were once much worse.

On Transportation, Student Aid, and Jobs

Is There a Better Way?

To the Editor:
Your April, 1970, issue (*pp. 69-70*) carried an article on certain British rail research which interested me to the extent that I felt I wanted to call it to the attention of the Secretary of Transportation, John Volpe. In response he has written me as follows:

"I am happy to report that we are not as out of touch or as unaware of the possible solutions as it might appear on the surface. While our more advanced developments are in the limelight, we have in fact been quietly moving forward with our rail-related research and development. It is a relatively modest program, awaiting enactment of the rail passenger bill and the rail safety bill to provide a framework for a more intensive effort. But we are taking advantage of overseas work as a major input to our studies.

"The British Railways engineers, who are doing the advanced passenger train, are our consultants on the 250-m.p.h. linear induction motor research vehicle which we are beginning to test at this time. Also, the plasma torch work mentioned in *Technology Review* was sponsored in part by this Department. Both the Japanese National Railways and French National Railways have been exchanging technical information with us for several years, and we are currently developing exchange programs with West Germany and Italy.

"There can be no question that our rail potential is underutilized, but the real problem is not basic technology. Rather, it is institutional and commercial. That is why the rail passenger legislation and our efforts to broaden the concept of a trust fund are so important. We are also deeply involved in the complex financial framework of our private railroad industry. All of this bears heavily on our ability to apply available technology to our transportation problem through the rail mode."

I am still of the opinion that a lot more could be done than is being accomplished, even within the framework of our present facilities, but perhaps I'm being impatient. Surely there must be better answers to our transportation needs than thousands of monstrous trucks roaring over our already inadequate highways, millions of motor cars adding at an ever increasing rate to an already difficult traffic problem (and an increasingly burdensome pollution situation), and aircraft in jumbo proportions which threaten our hearing by day and night.

Albert R. Sims
Concord, Mass.

Self-Driven Taxis?

To the Editor:
It seems to me that Martin Wohl's article, "Urban Transit We Could Really Use," (*see* Technology Review *for June, 1970*), overlooks an important possible type of transportation. This is what I would call the self-driven, short-haul rented taxi.

In the limited areas of central cities, where pollution and traffic density is the greatest, such taxis can play a major role. No doubt the conventional taxi is necessary to a large proportion of the urban population, especially the aged when they can afford it; but such transportation exacts a fairly heavy price by virtue of needing a driver. A self-driven short-haul rented taxi would eliminate this major expense and at the same time allow other important advantages to be realized.

Because distances are short in central cities, such rented cars could be electric powered just as conventional taxis might very well be. The way I conceive their use, every three or four blocks a number of rented self-driven vehicles would be stationed, available to any authorized driver and returnable only to a similar station close to the driver's destination. At this point in computer technology, authorization by insertion of a driver's license incorporating a device such as a magnetic strip into an automatic reading station offers no great difficulty; and the fee would be calculated and recorded by similar means.

The advantages would be the availability of clean, reasonable, flexible, private transportation, a mode of transportation that, at present, most people seem to prefer. The total number of cars in the city would be drastically reduced since the number of cars needed at any point in time would be only slightly more than the number of cars actually in use and not as at present a multiple of this number, including all cars stored in the city, cluttering up streets and garages. Moreover the space taken up by the total car population would be further reduced because such self-driven rented cars, by virtue of their limited short-haul function, could be smaller than the standard American car, something in fact approaching small European car dimensions. And last, moving traffic in the cities would be preserved. Although in a great many locations this might be a dubious advantage, it must be recognized that in present-day central cities the presence of traffic helps to police, helps lend a certain security to otherwise deserted and therefore dangerous areas.

Such vehicles could be painted a distinctive color so that should they be stolen or taken beyond city limits, they would be immediately recognized. All other cars, except buses, trucks, and conventional taxis, would of course be prohibited from entering the central city. Variations on and additions to such a system (small self-driven rented buses or trucks for moving furniture, etc.) as well as abuses can be imagined, but none so serious as to constitute a major obstacle.

The automobile is a resistant breed of transportation and for good reason. But it has to be tamed and once housebroken by the utilization of the technical resources available, there is no reason why it can't continue to be used successfully in central cities and used without pollution or traffic jams. Properly organized, such a system would not only free the cities and in a manner of speaking free the users; it would, I am sure, provide a handsome profit to whoever undertook to provide such a service.

Alvin Lukashok
New York, N.Y.

A Correction
In its October/November issue (p. 95), Technology Review *published some*

earlier comments from readers on Mr. Wohl's article, together with a statement which proposed to be a response to some of these comments by Mr. Wohl. It now comes to our attention that the comments attributed to Mr. Wohl were published without his authorization and were indeed not intended for publication. The Review *regrets the misunderstanding, which clearly occurred in its own editorial offices.—Ed.*

Minnesota Corrected

To the Editor:
Minnesota spends a great deal of money on post-secondary education. We have a famous university and fine state college, junior college, and vocational school systems. We have a state scholarship program and a grant system for the disadvantaged.

We have not, however, evaded capital spending by offering grants to students to send them to institutions in other states.

Our legislature is friendly to education. We have not seriously considered the kinds of legislation to which *Technology Review* refers in the July/August issue (*pp. 67-68—on the suspension of financial aid to disruptive students—Ed.)* To single out Minnesota with the word "notably" is unfair on two counts:

1. We have no statutes aimed at students.

2. The subject of your article is the national effect of such legislation. We do not offer scholarships outside the state, so reference to Minnesota is wholly out of order.

E. T. Herbig, Jr.
St. Paul, Minn.

Mr. Herbig, a member of the M.I.T. Class of 1937, is President of the Minnesota Higher Education Coordination Commission. We are grateful for his statement of clarification.—Ed.

Man's Unfathomable Spirit

To the Editor:
Some suggestions for graduate education came to mind as I read John Alden's article, "Graduate Engineers—Who Needs Them?" (*see* Technology Review *for July/August, 1970*).

My notion is that after a Master's degree a man should work for four years—at anything, whatever he might be hired for—and then return to complete work for the Ph.D. in his chosen profession. He might do enough at his work to become a philosopher, even though in four years he published nothing, and he would have developed his verbal talents and his ability to deal with men.

I do not believe much can be learned via statistics about the ability of a man to live and work with other men, except possibly to give him a numerical classification meaning very little. Why? Because the spirit of man is unfathomable and it has a great bearing on his success in life. You cannot make statistics of it. For example, some men with very little scholastic training make the finest executives. They learn to know, or have insight into, the behavior of man—not learned from books.

Frank G. Smith
Honolulu, Hawaii

On Heat and Balance

To the Editor:
Few people realize how far we have already gone down the road to unintended weather modification, altering our environment. Consider any large city. All the coal, gas and oils shipped in end up as heat. The tons of food brought in fuel the millions of human heat generators. Imported electricity ends up as heat except that going into waves (light, sound, radio, etc.) which may themselves end up as heat for all I know.

The only offset is the warmer temperature of the sewage effluent—which does not go far away—than the incoming water supply, plus the increased radiation and convection.

If we air-condition half a given volume down 10°F, we automatically heat the other half—the environment—by 10°F. Then the conditioner has to work against 20°F plus the heat of the power used. This ever-increasing heat differential has the earmarks of a vicious spiral.

On the other hand, the energy (heat) the hydroelectric plants take from the river systems cools their environment, increasing the temperature gradient to the cities. This would seem bound to affect the formation and progression of highs, lows and fronts.

It is argued that fueled power plants should install cooling towers to heat the air instead of the river. The consequent discharge of warm extra-humid air is bound to affect the weather if the practice becomes general.

We could partially restore the pristine balance of natural temperatures by moving our fueled power plants around into the hinterlands, especially to rivers like the Tennessee and Columbia, where the rivers' heat energy is sent away to the thickly settled areas. But I fear we will find it an impossible task to heat our rural areas as much as we heat our cities.

Russell A. Trufant
Middleboro, Mass

The Winners Proclaimed

					Q 1	K 2		C 3	I 4	S 5	E 6	H 7	B 8	U 9	F 10		Q 11	J 12		E 13
M 14	Z 15		L 16	Y 17	A 18	N 19	C 20	W 21	I 22	K 23	G 24		Q 25	C 26	U 27	O 28	B 29	P 30		
M 31	X 32		T 33	U 34	S 35		P 36	D 37	Y 38	I 39		T 40	A 41	P 42	N 43	C 44	K 45	R 46	H 47	
Q 48	B 49		E 50	T 51	N 52	I 53		R 54	L 55		O 56	Y 57	G 58		L 59	C 60	M 61	B 62	V 63	
T 64	G 65	D 66		R 67	X 68		T 69	N 70	B 71	C 72	F 73	M 74	D 75	R 76	J 77	A 78	H 79		Y 80	
X 81	K 82		Z 83	B 84	N 85	R 86	C 87	I 88	Q 89	G 90	D 91	O 92	K 93	V 94	Y 95		V 96	W 97	C 98	
S 99		Z 100	D 101	J 102	F 103	A 104	T 105	Z 106		W 107	G 108	I 109		B 110	C 111	I 112	L 113	F 114	H 115	
	V 116	I 117		U 118	A 119	U 120	O 121	Q 122	X 123	C 124	V 125		G 126	E 127	C 128	P 129	X 130	V 131	H 132	
	T 133	N 134		L 135	G 136	D 137	N 138	K 139		Y 140	E 141	S 142	V 143	X 144	I 145	L 146	M 147	F 148	U 149	
B 150		P 151	R 152	I 153		E 154	V 155	B 156	A 157	I 158		D 159	F 160	Y 161	M 162	I 163	A 164			

Use the definitions at the right to help define the words to which they refer; then enter the appropriate letters in the diagram to complete a quotation from a scientific work. The first letters of the defined words give the author and title from which the quotation is taken. Black squares in the diagram indicate the ends of words; when there is no black square at the right end of the diagram, the word continues on the next line.

The correct solution to this Tech-Crostic will appear in the February issue of *Technology Review*.

David L. Holt is Assistant Professor of Metallurgy at M.I.T. He will welcome readers' comments; address him in care of *Technology Review*, Room E19-430, M.I.T., Cambridge, Mass. 02139.

A. Failed to follow suit.

41 78 119 157 18 104 164

B. Slopes.

49 84 62 150 8 29 71 156 110

C. Cooperating; yielding to applied energy.

87 26 124 44 60 128 20 72 111

98 3

D. Persian god of light.

66 91 75 101 137 37 159

E. Uncivilized.

127 141 6 50 154 13

F. Shred.

73 114 148 160 10 103

G. A lead-gray sectile silver telluride.

108 24 65 126 136 90 58

H. Earthquake.

132 7 47 79 115

I. Grew by rapid production of new parts.

145 112 4 88 22 117 163 158 39

53 109 153

J. See Word Z.

102 12 77

K. Portions of four-dimensional space-time.

2 23 82 93 139 45

L. See Word N.

16 59 135 55 113 146

M. Flight or exodus; specifically, flight of Mohammed from Mecca.

14 147 61 74 162 31

N. Watertight box or chamber.

43 85 52 134 138 70 19

O. Holy Roman Emperor, 936-973.

92 28 56 121

P. Elementary being; organic unit.

30 42 129 151 36

Q. British Antarctic explorer and geologist.

122 89 1 25 11 48

R. Identity in pitch.

76 86 67 46 54 152

S. Clear of allowances, deductions, etc.

5 35 99 142

T. First word of medieval (Latin) manuscripts.

64 51 69 133 40 105 33

U. Plants related to the onion.

120 34 118 9 149 27

V. Type of computer.

94 63 155 131 116 125 96 143

W. Trinitrotoluene or trinitrotoluol.

107 97 21

X. Chief goddess of the Babylonian pantheon.

123 32 81 68 130 144

Y. Calcareous concretion in the internal ear.

161 38 17 95 140 80 57

Z. Salamander.

106 15 100 83

A Celebration: 15 Winners!

To celebrate Tech-Crostic's first full year in nine issues of *Technology Review*, the Editors announced a prize, to be awarded to that reader in each major zip code area who first mailed a correct solution to the October/November Tech-Crostic. It turned out to be a three-way tie in zip-code-area 0 and a two-way tie in 5, as you'll see in this list of winners; and there are also non-zip-code entries from Canada and Australia in the list:

John T. Christian, Waban, Mass., 02168
A. E. Hale, Glastonbury, Conn., 06033
Henry S. Lieberman, Waban, Mass., 02168
John V. Schoeller, Bethlehem, Pa., 18017
Winslow H. Hartford, Charlotte, N.C., 28211
John Siegel, Miami Lakes, Fla., 33014
Mrs. Jane Koplik, Shaker Heights, Ohio, 44120
E. Nordstrom, Minnetonka, Minn., 55343
Larry Schmidt, Minneapolis, Minn., 55432
Howard I. Dwyer, Glen Ellyn, Ill., 60137
Robert Rein, Norman, Okla., 73069
John R. Hopkins, Los Alamos, N. Mex., 87544
William J. Wagner, Menlo Park, Calif., 94025
C. R. Stempf, Newport, N.S.W., Australia
W. M. Berry, Regina, Sask., Canada

To the many readers who made such friendly comments about Tech-Crostic and about *Technology Review*, Professor and Mrs. Holt—and the Editors—send deepest thanks; to the winners, congratulations; and to those readers frustrated by the vagaries of mail and geography, our condolences. For the next celebration we promise a different measure of acumen.

December Tech-Crostic Solution

The essential nutrients are the most important units with which biochemists in every segment of the science deal in extending knowledge of the phenomena of life.
—McCollum, *A History of Nutrition.*

Who Owns the Zebra?

I erred in writing the October/November issue by not mentioning that "speed" problems are for personal edification only; solutions are not published. So I must apologize to those who have responded.

Let me thank everyone who answered my request for "speed" problems. I could use more, but the supply is no longer critical. As for regular problems, the most descriptive comment is that today, November 15, I am using problems received in April. Please be patient.

Problems

As usual, we begin with a bridge problem—this one from John Rudy:
11 Given the hands shown and the bidding as listed,

	♠ 8 6 ♥ A K x ♦ Q 9 7 ♣ A 10 9 x x	
♠ A Q 10 x x ♥ Q J 10 x x ♦ x ♣ J x		♠ J 9 ♥ 9 x x x ♦ x x x ♣ K Q x
	♠ K x x ♥ x ♦ A K J 10 8 5 ♣ x x x	

South	West	North	East
1 diamond	1 spade	2 clubs	pass
2 diamonds	2 hearts	3 hearts	pass
3 no-trump	4 hearts	5 diamonds	pass
pass	pass		

and West's lead of the ♥ Q, show that if the declarer wins the first trick with the ♥ A then he must lose two spade tricks and a club when East gets in with the ♣ K.

The following is from Arthur W. Anderson:

12 Show that for every odd positive integer n, sin nx can be expressed in the form $\sin nx = a_1 \sin x + a_3 \sin^3 x + \ldots + a_n \sin^n x$ and derive a general formula for the coefficients a_k.

A geometry problem from George E. Keith, Jr.:

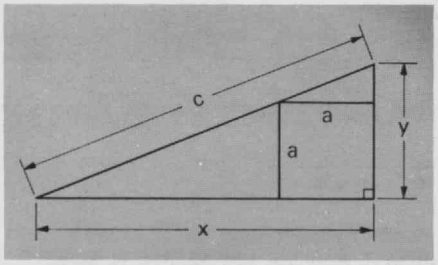
13 Given a convex quadrilateral ABCD with diagonals AC and BD, and given that
AC = BD
Angle BAC = angle CAD
Angle CBD = angle BDA
prove that the quadrilateral is a trapezoid.

Here's a navigation problem from Clark Thompson:

14 Starting from a point 40°N 88°W, a man walked 200 miles due north, then 400 miles due west, 400 miles south, 400 miles east, and finally 200 miles north. To his amazement, he was not at his starting point. How far away was he?

Our final problem is from John L. Sampson:

15 Given the following, find x and y in terms of a and c.



Speed Department

Our first quickie is from John E. Prussing:

SD5 Two trains start at 10 a.m., one going from Boston to Washington and the other from Washington to Boston. The first train takes six hours for the trip and the second train takes nine hours. Each travels at a constant rate with no stops. At what time of day do the trains meet each other?

Finally, Alec Henderson and *Readers Digest* offer the following; Mr. Henderson notes that while it does not involve any mathematics, it requires a good deal of logic:

SD6 The facts essential to solving the problem—which can indeed be solved by combining deduction, analysis, and sheer persistence—are as follows:
1. There are five houses, each of a different color and inhabited by men of different nationalities, with different pets, drinks, and cigarettes.
2. The Englishman lives in the red house.
3. The Spaniard owns the dog.
4. Coffee is drunk in the green house.
5. The Ukrainian drinks tea.
6. The green house is immediately to the right (your right) of the ivory house.
7. The Old Gold smoker owns snails.
8. Kools are smoked in the yellow house.
9. Milk is drunk in the middle house.
10. The Norwegian lives in the first house on the left.
11. The man who smokes Chesterfields lives in the house next to the man with the fox.
12. Kools are smoked in the house next to the house where the horse is kept.
13. The Lucky Strike smoker drinks orange juice.
14. The Japanese smokes Parliaments.
15. The Norwegian lives next to the blue house.
Questions: Who drinks water? And who owns the zebra?

Solutions

41 A canary is hovering inside a submarine when the submarine finds its neutral equilibrium in water. When the canary gently lands on the submarine deck, does the submarine go down?

Robert D. Shooshan solved this one; he writes: "This problem reminds me of a cartoon I once saw, a three-ton truck crossing a bridge with a three-ton load limit. The driver, beating on the body with a stick, explained to his helper 'We have a two-ton load of pigeons and I want to keep them flying until we get across this bridge.'

"The canary hovering inside the submarine is exerting a force on the surrounding air equivalent, in the vertical direction, to its weight. The air is pushing against the deck while the bird is hovering. When the canary gently lands, its weight on the deck is equivalent to, and replaces, the downward air current. Therefore, the submarine remains in equilibrium."

Also solved by Charles H. Blake, Jerry Blum, Dale Epstein, Rockwell Hereford, Mark Leonard, James Marler, Jr., Eric Rosenthal, R. Robinson Rowe, Frank

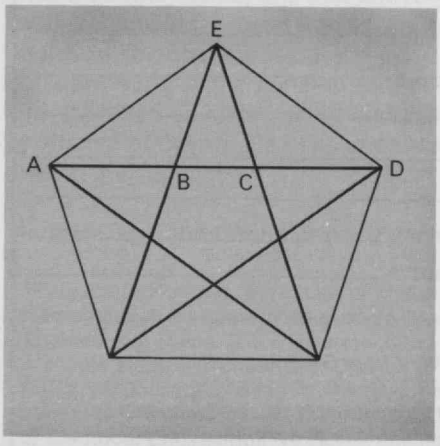
Rubin, John Rudy, Les Servi, and James Sinclair.

42 Find the next term in the following series:
18 46 94 63 52
The Perseverance Award goes to Donald C. Berkey and Dr. Robert E. Hoffman. Mr. Berkey's first solution was mailed August 25. Two days later it was amended. On September 9 Mr. Berkey and Dr. Hoffman reported the following seven equations, with the value n = 5 given in parenthesis and italics just after each equation:
$18 + 99 \sin^2(n\pi/4) - 31.5n + 10n^2$ (*160*)
$18 - 24.75 \sin^2(n\pi/2) + 67.5\,n - 14.75n^2$ (*−38*)
$18 - 64.5n + 150.25n^2 - 66n^3 + 8.25n^4$ (*358*)
$18 + 88 \sin^2(n\pi/3) - 114 + 92.5n^2 - 16.5n^3$ (*−236*)
$72 \sin^2[(n+1)\pi]/6 - 94.5n + 133.75n^2 - 54n^3 + 6.75n^4$ (*340*)
$18 - 10 \sin^2(n\pi/2) + 34/3 \sin^2(n\pi/3) + 42 \sin^2(n\pi/4) + 34 \sin^2(n\pi/6)$ (*46*)
$18 + 12 \sin^2(n\pi/2) + 684 \sin^2(n\pi/6) - 192.5n^2 + 40.5n^3$ (*448*)
Finally Dr. Hoffman determined that (as they expected) any number K will satisfy the fifth term by the following formula:
$18 - 10 \sin^2(n\pi/2) + [(80 - K)/3] \sin^2(n\pi/3) + [(19 + K/2)] \sin^2(n\pi/4) + (80 - K) \sin^2(n\pi/6) + [(K - 46)/4]n$.
Finally on September 16 they arrived at the same solution as the proposer, namely 61; the series is generated by writing 9^2, 8^2, 7^2, etc., with the digits reversed.

Also solved by Jerry Blum, David Cantor, Walter C. Janney, Mrs. Martin L. Lindenberg, James Marler, Jr., Eric Rosenthal, Robert Rosin, R. Robinson Rowe, Heinrich Ruschat, Jerrold Sabath, George S. Sacerdote, and Les Servi.

43 Outline the geometrical method of drawing the five-star insignia of our top military commanders. If W is the width of any star, can anyone determine the ratio K of the distance between adjacent star points to W?

The following is from Eric Rosenthal:



I assume AD is the "width."
In triangle ABD, AB/(sin AEB)
= AE/(sin ABE)
AB = AE[(sin AEB)/(sin ABE)]
= AE[(sin 36°)/(sin 108°)]
Now (sin 36°)/(sin 108°) = (sin 36°)/(sin 72°) = (sin 36°)/(2 sin 36° cos 36°)
= 1/(2 cos 36°), so AB
= AE/(2 cos 36°).
In triangle BCE, BC/(sin BEC)
= BE/(sin BCE)
BC = BE[(sin BEC)/(sin BCE)]
= BE(sin 36°)/(sin 72°).
Since AB = BE and (sin 36°)/(sin 72°)
= 1/(2 cos 36°),
BC = AB/(2 cos 36°)
= AE/(2 cos 36°) (2 cos 36°).
Now AD = AB + BC + CD
= 2(AB + BC) = 2[AE/(2 cos 36°)]
+ AE/(4 cos² 36°)
= AE[1/(cos 36°) + 1/(4 cos² 36°)].
In the solution to problem 30 in the July/August issue, you give
$\sin 36° = \sqrt{10 - 2\sqrt{5}}/4$.
So $(\cos^2 36°) = 1 - (\sin^2 36°) = 1 - (10 - 2\sqrt{5})/16 = (6 - 2\sqrt{5})/16$
and $\cos 36° = (\sqrt{6} + 2\sqrt{5})/4$.
So K/W = AE{AE[1/(cos 36°) + 1/4(cos² 36°)]}

$$= \frac{1}{(\cos 36°)/(\cos^2 36°) + .25/(\cos^2 36°)}$$

$$= (\cos^2 36°)/[.25 + (\cos 36°)]$$

$$= \frac{(6 + 2\sqrt{5})/16}{.25 + (\sqrt{6 + 2\sqrt{5}})/4}$$

$= (3 + \sqrt{5})/2(1 + \sqrt{6 + 2\sqrt{5}})$.
Also $(\cos^2 36°)/[.25 + (\cos 36°)]$
$\approx 0.65451/(0.25 + 0.65451)$
$= 0.65451/1.05902 \approx 0.61803$.

Also solved by John E. Prussing and Frank Rubin.

44 A certain physicist is studying a nuclear reaction with very precise equipment. He can sort out and store separate atoms and observe when a gamma ray is emitted by any of his collection, but he cannot tell which one has changed or tell whether a neutron was released or absorbed also. His equipment has a balance sensitive enough to weigh any or all of the atoms and finally to sort out the single atom and determine the process. After 282 atoms are isolated, a gamma ray is detected; as the weighing process is exceedingly tedious, the physicist seeks to determine the method that will yield the answer in the least number of weighings. While the physicist is checking the data on a computer—with a tremendous amount of identical parallel circuits feeding in—there is a breakdown; the operators have difficulty in isolating defective circuits. The physicist therefore comments, "If you people have as sensitive a nulling ammeter as I have a balance and can parallel all the inputs and outputs as you please, I can determine which component is open or shorted in less than 11 comparisons if the total number of elements is not much more than 68,000." To fulfill his promise, what (1) was the least number of weighings of the atoms made by the physicist; and what (2) is the greatest number of circuits he could check with 11 comparisons?

Only Frank Rubin responded:

A simple induction establishes that in n weighings you can determine the odd-weight item, with direction of error, from $(3^n - 3)/2$ items. In this case n = 6 is required. (Note that $x_{n+1} = 3(x_n + 1)$ is the identity used for the induction.) But the second half of the problem is incomprehensible. How many inputs and how many outputs does each circuit have? How many input/output combinations must be tried before concluding that a given circuit is open or shut? The nature of each circuit seems relevant. Suppose they are binary triggers which change level outputs on every second pulse input. What then?

45 What time is it when the spread between a clock's hands (measured the short way) is an integral multiple of 13 minutes? No fractional minutes are involved, and the hands are pointed in different directions.

Many computer programs were submitted: the following, by Mark Leonard, is in FOCAL. 2:48 is the desired answer (the only one before 4:00).

```
*WRITE ALL
C-FOCAL , 8/68

01.10 FOR H=1,60; DO 2.0
01.20 TYPE !!!; QUIT

02.11 C H IS POSITION OF HOUR
      HAND, IN MINUTES.
02.12 C MINUTE HAND POSITION IS
      12 TIMES HOUR HAND
02.13 C SO THE DIFFERENCE IS 11
      TIMES H.
02.20 SET D=11*H
02.30 IF (D-60) 2.4 2.31,2.31
02.31 SET D=D-60; GOTO 2.3
02.40 C DIFFERENCE IS NOW LESS
      THAN 60.  SEE IF LESS
      THAN 30.
02.41 IF (D-30) 2.51,2.99,2.42
02.42 SET D=60-D
02.50 C D IS NOW SHORT WAY,
      LESS THAN 30.
02.51 IF (D) 2.99,2.61,2.52
02.52 SET D=D-13; GOTO 2.51
02.60 C IF WE GET HERE D WAS AN
      INTEGRAL MULTIPLE OF 13.
02.61 SET HOUR=FITR(H/5)
02.62 SET MINUTE=12*(H-<5*HOUR>)
02.70 TYPE !,%2.0,"TIME",HOUR,
      ":",MINUTE
02.99 RETURN
*GO
TIME=  2:= 48
TIME=  4:= 36
TIME=  7:= 24
TIME=  9:= 12
TIME= 12:=  0
*C EXECUTION TIME WAS ABOUT 15
   SECONDS, INCLUDING TYPING TIME.
```

Also solved by F. Steele Blakall III, Jerry Blum, Charles Bures, Rockwell Hereford, John Hornstein, Richard Lipes, Lyall D. Morrill, Jr., John E. Prussing, R. Robinson Rowe, Frank Rubin, John Rudy, James Sinclair, David B. Smith, and one anonymous correspondent.

Allan J. Gottlieb studied mathematics at M.I.T. with the Class of 1967 and is now studying and teaching at Brandeis University. Send problems and answers to him at the Department of Mathematics, Brandeis University, Waltham, Mass. 02154.

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		Totals	
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	@$14.00 dz.		-------

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TR-71

Special Report

The M.I.T. Commission: To a New View of Knowledge and Value

After more than a year of intensive study and against a background of nationwide developments out of which should come a change "in the whole ethos of the university" in the United States, the Commission on M.I.T. Education has proposed to the Institute faculty three major areas for special study, and possibly change, at the Institute:

◇ A new approach to undergraduate education to provide students "opportunities more appropriate to their individual needs and talents" and to better integrate all the elements of their education into "a more coherent intellectual foundation."

◇ A greater role for the M.I.T. faculty in making decisions by which M.I.T. responds to funding constraints and "the shifting pattern of career opportunities for scientists and engineers," and for all members of the academic community in consulting on and perhaps in making "the important decisions that affect the character and role of M.I.T."

◇ Renewing M.I.T.'s "national sense of purpose" by redefining "the relation of knowledge to values," by improving the environment for "humane learning," and by encouraging faculty and students to "play an active role in determining and implementing public policy in areas of great social concern."

If it can be said that the Commission's report (of which the summary chapter appears in full beginning on page 92 of this issue of *Technology Review)* has a central theme, it is that M.I.T.—in all its teaching, research, and public service activities—must add to "its historic commitment to excellence in all fields of science and technology . . . the pressing need to unite the pursuit of knowledge with a concern for social responsibility in the use of that knowledge." Such an effort would encompass, for example, understanding the importance of the effects of science and technology as well as the facts out of which they advance.

Indeed, says the Commission, extending its argument outside M.I.T., "if there

In its first report, the Commission on M.I.T. Education (above) makes what Alex Makowski, '72, Editor-in-Chief of The Tech, *calls a "compelling argument" concerning undergraduate education. "A climate emphasizing an integrated education" is the Commission's new direction for undergraduate work, and it is the "most valuable contribution" of the Commission's report.*

*Kenneth N. Hoffman, Professor of Mathematics, is Chairman of the Commission. Its members include Samuel W. Bodman III, Sc.D.'65, Associate Professor of Chemical Engineering; Daniel S. Kemp, Associate Professor of Chemistry; O. William Lever, graduate student in chemistry; Charles E. Mann, '72, undergraduate in chemistry; Erik L. Mollo-Christensen, '48, Professor of Meteorology; Marvin A. Sirbu, '66, graduate student in electrical engineering; Louis D. Smullin, S.M.'39, Head of the Department of Electrical Engineering; Arthur R. Steinberg, Associate Professor of History and Archeology; Laurence Storch, '71, undergraduate in civil engineering; Lester C. Thurow, Professor of Economics; and Sheila E. Widnall, '60, Associate Professor of Aeronautics and Astronautics. Joel Orlen, Administrative Officer of the School of Science, is the Commission's Staff Director.

is a single, pressing need within the (American) university, it is that the preoccupation with matters of fact, in both the sciences and the humanities, be replaced by a recognition of the relatedness of knowledge and values."

The need to give knowledge value stands behind all the Commission's discussions of issues in undergraduate and graduate education and in the governance of M.I.T. Much of the report goes far beyond the Commission's final recommendations, so that it is possible—but apparently unfair—to read into the document proposals which would basically alter some longstanding characteristics of an M.I.T. education. At this level, says Professor Kenneth M. Hoffman, the Commission's effort has been to simulate discussion, not to propose radical change.

Undergraduate Education: a First Division

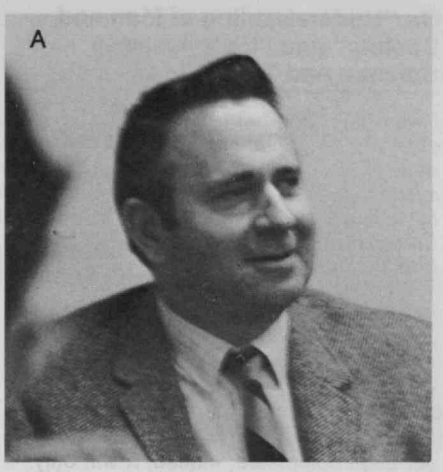
The new Commission joins its predecessors—notably the Committee on Education Survey in 1949—in stressing the central role of undergraduate education at M.I.T. The Commission applauds the considerable flexibility which has been introduced into undergraduate programs in the past decade, but it concludes that "the overall consequences of the effort have fallen far short of what ought to be our goal.

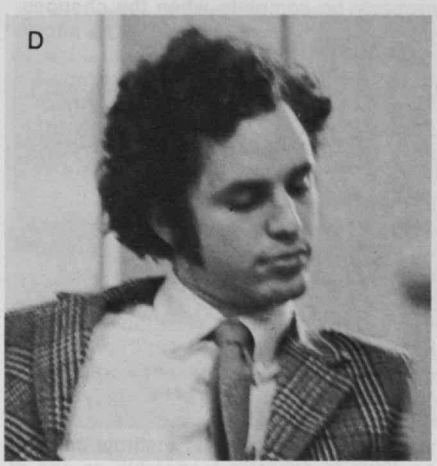
"The efforts to introduce students to a deeper understanding of science have not been successful. Most students continue, for example, to be more concerned with techniques than with the nature of mathematics as a way of thinking. . . . We have enlarged the scope and freedom of the first years of undergraduate education without developing the unifying principles which that freedom requires if it is to lead to something more than eclecticism." The need, it says—while admitting that the issue has been before M.I.T. since the end of World War II—is for imaginative new ways "to integrate scientific, social, and humanistic studies," to provide a coherent experience for undergraduates seeking to find their place in the Institute and in "the larger scheme of knowledge."

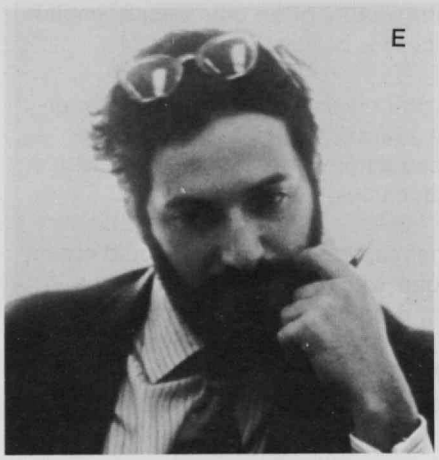
"Despite all the changes of the past decades," the Commission insists, "there remains at M.I.T. a decided bias against humanistic learning." The Commission proposes that "such fundamental questions as the nature of truth and explanation, the sources and validity of human values, the qualitative distinctions between styles and aesthetic judgments, the role of reason and passion in individual and social behavior—such questions as these ought to form the core of much of undergraduate education." It fears that "there is a restless, driven quality to life at M.I.T. that leaves little room for quieter intellectual activities, for the kind of moderate slackness that is often a condition of creativity and genuine communication;" but the Commission makes no specific recommendation on this issue, some members contemplating the possibility of developing small learning "communities" of 50 to 100 undergraduates.

Can such changes in fact be accommodated within the framework of a four-year undergraduate program in science or engineering? The Department of Civil Engineering, in a background statement supplied to the Commission last summer and now quoted in the Commission report, provides an interesting suggestion: if students, because of their deep concern with society's ills —including, for example, inadequacies of housing or transportation—are not motivated to proceed through mathematics and mechanics to a competence in analysis and design without a prior understanding of the broader issues, perhaps our goal in revising undergraduate curricula should be "to provide an understanding of the 'why's' and 'how's' prior to concentration on the detailed methodology."

To begin the task of changing undergraduate education at M.I.T.—which must go "beyond the kind of mechanical curricular tinkering (many) universities have heretofore called educational reform"—the Commission proposes that M.I.T. establish a new First Division through which the entire faculty would fulfill its responsibilities for the first two years of the undergraduate program.







Members of the Commission on M.I.T. Education, photographed during their many deliberations, are shown on this and the following pages:
A—Professor Kenneth N. Hoffman, Chairman
B—Professor Sheila E. Widnall, '60
C—Professor Louis D. Smullin, S.M.'39
D—Marvin A. Sirbu, '66
E—Professor Arthur R. Steinberg
F—Laurence Storch, '71
G—Professor Daniel S. Kemp
H—Professor Lester C. Thurow
I—O. William Lever
J—Professor Erik L. Mollo-Christensen, '48
K—Charles E. Mann, '72
L—Joel Orlen
M—Professor Samuel W. Bodman III, Sc.D.'56

The First Division would assure that responsibility for the first two undergraduate years is not "parceled out to several departments," as is now said to be the case. It would have administrative and budgetary responsibility for the freshman and sophomore general education program, and it would include an Experimental Section "with responsibility for initiating and evaluating major experimental educational programs."

Graduate Education: Breadth and Efficiency

Graduate education has been the Institute's fastest growing activity—and that which at present seems most jeopardized by economic and financial conditions. So economy and efficiency are put high on the Commission's list of objectives for M.I.T. graduate programs. But one problem surmounts these: "The Institute must recognize that it is faced with a new generation of graduate students who come here with new expectations and with attitudes that differ from those traditional among graduate students." They seek a "deeper personal involvement," they "mistrust" institutions and academic requirements, and they demand greater "social relevance" in their academic work.

M.I.T.'s response, says the Commission, must be to provide more flexibility for graduate students, as for undergraduates, "to broaden our definition of what a professional education should involve." The Graduate School should encompass a "more humanistic approach to technical progress," cultivating "a deeper understanding of the social consequences of science and technology and a more complex understanding of the social roles and the social obligations of professionals." And, because many graduate students go into academic careers, M.I.T. should provide some organized opportunity to develop teaching ability.

The Commission suggests development of predoctoral, intermediate degrees making fewer demands for independent research and general examinations. And, says the Commission, an M.I.T. education should continue

into lifetime learning; "the (traditionally close) . . . relationship between the Institute and its alumni can be strengthened by giving it an increased intellectual emphasis through . . . seminars and study programs."

Broadening the Base of Governance

Throughout its report, the Commission emphasizes new roles for students, faculty, and staff in the management of M.I.T., seeking "to ensure that those wishing to participate in decision making at M.I.T. will be able to express their views more effectively than in the past." But its report is ambiguous on the question of whether this broader base of participation is to be in consultation about decisions or in actual decision making.

The Commission notes, for example, that students throughout the U.S. now seek "the opportunity to fulfill themselves on their own terms, they ask that schools provide them with the freedom to make critical decisions about what they are to study." Indeed, says the Commission, "the energy and imagination of students is an important force in the vitality of an educational institution and can be of great benefit in the processes of governance."

At another stage in its report, the Commission insists that "creative leadership such as M.I.T. is likely to need in the years ahead . . . cannot be expected if every exercise of presidential leadership is subject to the veto power of any or all of the Institute's constituencies."

To effect its proposals for Institute governance, the Commission would create an Institute Council, a representative group with "weighted representation from faculty, undergraduate students, graduate students, postdoctoral fellows, staff, employees, and alumni." It would "discuss affairs of current interest," including "the relationship of M.I.T.'s activities in public service to its goals in education and research," and it would hear discussion of the annual budget each spring.

The Meaning of Knowledge and Value

Behind all of its recommendations, says the Commission, is its preoccupation with two questions confronting American universities: "What can be done to improve our definition of knowledge so that it does not automatically exclude questions of purpose? And, How can the university translate its concern for the integration of knowledge and values into programs of social action without compromising its commitments to the pursuit of knowledge and without jeopardizing academic freedom?"

Those who have awaited the report of the Commission on M.I.T. Education for the questions it would ask have been amply rewarded. It remains now to be seen if the Commission's questions are answerable—and if the answers to come from a dialogue of faculty, students, staff, and alumni which is just beginning can in fact lead M.I.T. into significant changes in method and goals.—J.M.

On "Understanding of Man and Society" and "Excellence in Science and Technology"

Following is the full text of the summary chapter, "Observations and Recommendations," of the first report of the Commission on M.I.T. Education presented by Kenneth N. Hoffman, Chairman of the Commission, to members of the M.I.T. faculty late in November.

In this time of turmoil and confusion, when many traditional institutions and beliefs have come under question, M.I.T. has in a sense submitted to self-examination by establishing this Commission. The work of the Commission has not yet been completed; indeed, it will only properly be complete when the changes we are recommending begin to be implemented. This report on the general issues facing the Institute is being issued now in the hope that it will promote further discussion and help move us closer to the job of implementation.

In the broadest sense, our aim in this report and in others that will follow is to urge the M.I.T. community to undertake a serious and thoroughgoing effort of creative renewal. In urging this course, we are aware that many of the problems facing M.I.T. are beyond our capacity to control; but we are equally aware of M.I.T.'s record as a force for innovation in education, research, and public service. We believe that the Institute can continue to exercise leadership as one of the nation's great institutions of higher learning only if it acts boldly to initiate changes in its approach to education and research to suit new conditions and needs. Our predecessors made timely changes in the past; it is up to us to redesign M.I.T. so that it will be prepared to offer what Elting Morison has called "an education for the twenty-first century," an education, that is, which is built upon broad scientific foundations and extends to include an understanding of man and society.

In calling for a renewal of M.I.T.'s traditional structure and goals, we begin from the premise that the Institute should maintain its historic commitment to excellence in all the main fields of science and technology.

This commitment, however, must be joined to a recognition of the pressing need to unite the pursuit of knowledge with a concern for social responsibility in the use of that knowledge. M.I.T. graduates must be prepared not only with the skills they will need to excel as scientists, engineers, and administrators, but also with the breadth of understanding they must have if they are also to become responsible professionals. M.I.T. itself must set an example for its students and for society by providing an environment not only for scientific research and training but for humane learning in the fullest sense. This can only be an environment in which a serious effort is made to integrate different approaches to knowledge and in which research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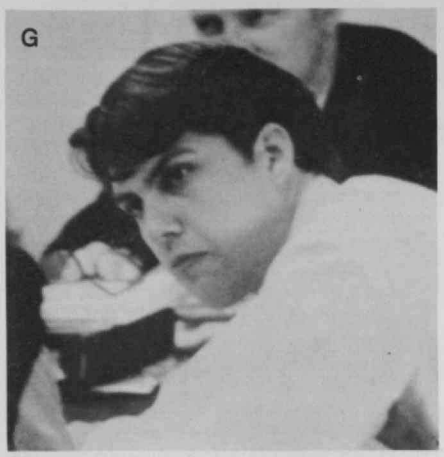
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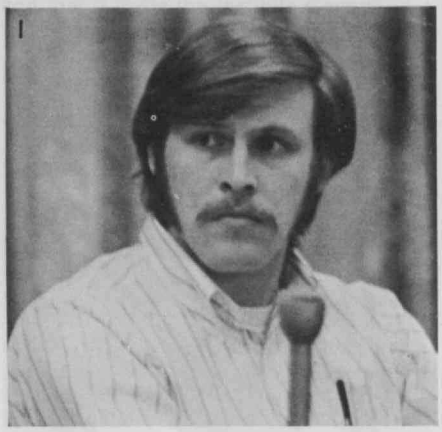
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capacities are devoted to identifying and helping to solve major social problems, including those of the natural and urban environment, poverty and ghetto conditions, and those that arise out of the applications of science and technology to international conflict.

In order for M.I.T. to pursue these new directions energetically and successfully, it is essential that our community be knit together by a sense of common purpose and a will to cooperate. Such a degree of unity can only be achieved if efforts are made to cultivate, by formal and informal means, a new spirit of trust and mutual confidence among all segments of the Institute community.

Commission Recommendations

Undergraduate Education

It is time for us to reexamine and revise our approach to undergraduate education, especially in the first two years, both in order to offer students opportunities more appropriate to their individual needs and talents and to provide a more coherent intellectual foundation for professional education.

Throughout American higher education, the undergraduate years have increasingly come to be devoted to preparation for graduate training. At M.I.T., where professional education has always been a central concern of the undergraduate program, we have been moving in the opposite direction. As a result of studies by the Lewis Committee (1949) and the Committee on Curriculum Content Planning (1964), the undergraduate curriculum and requirements have been revised in order to provide a broader foundation for professional education.

Changes introduced in recent years have made the system more flexible and more open to student determination. The deepest aims of these reforms, however, have not yet been fully realized. Early M.I.T. education is not as coherent or as personal as it ought to be, nor does it succeed in stimulating students to be concerned with fundamental and broad issues that cut across the separate disciplines.

The students who are now coming to M.I.T. bring with them a complex set of new expectations and needs, including intense desires for self-determination, for understanding the relationship of specialized study to larger intellectual frameworks, and for joining knowledge with action.

In order to improve our capacity to meet these needs and expectations and to fulfill the intentions of the reforms recently introduced, the Commission recommends that early undergraduate education be recognized as the responsibility of the Institute faculty as a whole rather than of the limited number of faculty from the various departments which teach subjects taken in these years; that a new First Division be established as an institutional focus for innovation with administrative and budgetary authority for general education in the first two years; and that within this division an Experimental Section be formed to encourage faculty members to develop and initiate new programs of instruction.

The new programs should be aimed at providing undergraduates with a choice of a number of coherent, broadly interdisciplinary, and small-scale educational experiences involving close working relationships with faculty and other students. Certain of the programs might be modeled after two experiments already in existence, the Experimental Studies Group and the Unified Science Study Program. Program topics could include such subjects as the social consequences of science and technology, the different approaches to knowledge in the humanities and sciences, and the nature of design from a variety of perspectives. Some might incorporate freshman seminars. A new interdisciplinary major might be offered as a four-year program. The departments and schools should be encouraged to offer courses examining the nature and role of the various professions and the relation of disciplinary knowledge to other forms of understanding. An experiment might be undertaken to test the desirability of early admissions to undergraduate study—a step which could have far-reaching implications for the future format of M.I.T. education.


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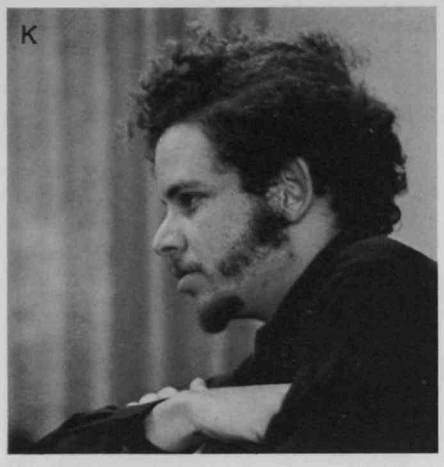
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The overall aim of the programs would be to encourage students to develop a broader outlook, as well as an individual capacity for creative synthesis and self-education. It would attempt to achieve this objective by encouraging many more M.I.T. faculty members to commit their energies and talents to imaginative efforts in undergraduate education.

Graduate Education and Research

Uncertainties concerning the level of public funding for research and higher education, coupled with the shifting pattern of career opportunities for scientists and engineers, will require adjustments in Institute policies and programs. It is imperative that the faculty play an active and influential role in making the decisions that will be needed to cope with these changing constraints and conditions.

The expansion of graduate education at M.I.T. and other American universities has come about as a result of greatly increased federal funding for research and professional training. Now that priorities seem to be changing and funds have been cut back, many universities fear they may be critically overextended. In the light of this financial crisis, it is necessary that M.I.T. review its commitments to graduate education.

The financial crisis should be regarded as an opportunity for a fundamental reexamination of the aims of graduate education. In view of the social need for responsible professionals, it is imperative that M.I.T. deliberately seek to cultivate among its students at all levels a deeper understanding of the social consequences of science and technology. An understanding of the nature of this responsibility should be built into our criteria of competence in science and engineering education. Another concern should be to improve opportunities for graduate students to acquire training in teaching, since many of them now enter the teaching profession, especially at the college and university levels, without significant prior experience.

With respect to degree programs, the Commission believes that requirements should be modified for the sake of greater economy and efficiency, especially with regard to residency and other requirements for the Ph.D. We urge increased stress on the development of broader, three-year interdisciplinary programs leading to the master's degree. We recommend the development of predoctoral, intermediate degrees and an alternative to the doctorate that does not require original contributions to knowledge but recognizes a dimension of excellence in another area. We recommend that the schools take greater responsibility for the coordination of graduate programs and educational development. We also recommend that the Institute, in cooperation with the Alumni Association, formulate an integrated plan for continuing education.

In general, the Commission recommends that the graduate program be reviewed with the needs of the individual student taken as the central concern and with special attention to a number of problem areas, including the nature of the responsibility of the schools for graduate degrees, the need for an internal review system to examine department programs, the delineation of rights and responsibilities of faculty and students in relation to doctoral study, and the role of teaching and internship in graduate training.

In regard to research, the Commission points out that M.I.T.'s overall budget is heavily dependent upon research funding. Cutbacks in such funding will therefore require difficult adjustments. These adjustments should not be left solely to the discretion of the administration. Questions of priority and balance, as well as appropriateness to the educational mission of the Institute, should receive the attention of the faculty. The faculty must not abdicate its responsibility for establishing guidelines for academic research policy. The Commission therefore recommends that the Committee on Educational Policy become the principal instrument for the formulation of faculty policy in research as well as education and that two standing committees be created to share in this process: a Committee on Undergraduate Educational Policy and a Committee on Graduate Educational and Academic Research Policy. We also recommend

that the C.E.P. prepare and review guidelines for policy in research and education, that it advise faculty and administrators in doubtful cases, and that it provide for faculty discussion of controversial proposals.

Especially in view of the fiscal constraints under which the Institute must currently operate, the Commission believes that the administration should prepare a budget summary for presentation annually to the M.I.T. community, along with a discussion of likely consequences. We also suggest that better procedures be developed for choosing which programs to maintain, curtail, or initiate, and for equalizing faculty work loads.

Governance

The turmoil M.I.T. and other universities have recently experienced makes it imperative that we redefine the rights and responsibilities of membership in the academic community and that we provide more opportunities for all who wish to do so to participate directly and indirectly in the making of the important decisions that affect the character and role of M.I.T.

In this report, the Commission addresses itself to general issues of governance. We do not recommend drastic changes in "the power structure" but we do propose modifications aimed at broadening participation in Institute decision making.

The Commission begins from the premise that the fundamental aim of government at M.I.T. is to enable faculty and students to pursue their goals in education and research effectively. If this function is to be performed well, however, it is essential that M.I.T.'s instruments of authority enjoy the confidence of the community. This confidence can result only from a sharing of responsibility, a ready communication of information, and regular and broad consultation with all elements of the community affected by Institute policies. The Commission believes that the M.I.T. tradition of effective and creative administration at the center should be maintained. We feel that efforts to improve the system of governance should emphasize the building of trust rather than the devising of cumbersome legalistic accommodations that tend to be sought when trust is lacking.

After much study of the problem of governance at M.I.T. and at other universities, a Commission task force has concluded that there is no single set of precepts and no empirical evidence that points toward a universal formula that can be applied to educational governance. Adjustments must be made in the light of institutional traditions and character. It is essential, however, that in the years ahead a steady effort be made to distribute the burdens of authority more widely among faculty, students, and trustees as well as administrators.

The Corporation. The Commission welcomes the initiative of the Corporation in seeking, through the creation of the Corporation Joint Advisory Committee and the procedures for consultation with the faculty developed by the Corporation Committee on the Presidency, to improve communication with the Institute community. We also express approval of the Corporation's announced intention of adding young alumni representatives to its ranks. The Commission recommends that the Corporation prepare a description of its activities for the information of the community and that it continue to seek improved communication with faculty and students. We also recommend that the Corporation go on record as favoring the creation of an Institute Council (to be described below) and that it invite the Institute Council to nominate candidates for election as "public" members of the Corporation. In the future, the corporation should also play a more active role in ensuring that basic educational goals are set and pursued vigorously by the academic community.

The Institute Council. The creation of an Institute Council is proposed in order to provide a forum for continuing discussion of Institute policies by representatives drawn from all segments of the community. In the view of the Commission, the council should consist of 60 members, with weighted representation from faculty, undergraduate and graduate students, postdoctoral fellows, staff, employees, and alumni.

The Judicial System. The Commission's Judicial Panel will propose a statement of rights and responsibilities and a common judicial system for the academic portion of the community. The panel will propose that if this system is adopted, an academic subgroup of the Institute Council be given the responsibility for overseeing its operations.

The Faculty Meeting. The Commission recommends that the Faculty Meeting be maintained generally in its present form, except that the rules be permanently modified to allow visitors to attend, to give speaking privileges to representatives designated by students, and to permit student associations and independent petitioners (of an appropriate number) to place motions before the meeting. The Commission also recommends that the C.E.P. review the present committee structure, especially in relation to the proposed Institute Council.

The Role of the Students. With respect to student participation, the Commission examines some of the arguments for and against. We conclude that the energy and imagination of students can play a highly beneficial role in university government, but that the value and extent of this contribution should take account of the limited personal stake which individual students may have in the long-term consequences of certain decisions. The Commission notes that if its proposal for an Institute Council is adopted, students will participate in governance through representatives in six important ways: as members of faculty committees, a Corporation committee, the General Assembly and Graduate Student Council, living group governance councils, and the Institute Council, as well as through the exercise of speaking privileges at faculty meetings. Student participation is a continuing concern of the Commission's Governance Task Force and must also be a major concern at the level of the departments and schools, where student participation close to their educational experience is perhaps most meaningful.

The Office of the President. The Presidency has traditionally been a powerful office at M.I.T. We appear to be on the brink of a significant structural shift, however, in which the power of the President will depend more than ever on his ability to communicate with and persuade a broad spectrum of faculty and student opinion. Creative leadership such as M.I.T. is likely to need in the years ahead, however, cannot be expected if every exercise of presidential leadership is subject to the veto power of any or all of the Institute's constituencies. Democratic leaders, the Commission believes, can be effective only when they are held accountable for all of their actions, rather than for particular decisions which may be unpopular. It is essential, however, that the President be in touch with the opinion of the community. For this reason, it is recommended that he make an annual personal presentation to a joint meeting of the Institute Council and the Faculty and that there be a review of Institute policies at five-year intervals. The Commission also urges that the President be relieved of certain of his administrative burdens in order that he be free to focus primarily on the educational affairs of the Institute, especially with respect to long-range questions. Within the office of the President, the public service functions of the Institute might be given sharper focus; depending upon the style of the next President, it may also be advisable for the Provost rather than the President to chair the Academic Council. Both these changes would help to permit the President to concentrate his energies on educational priorities.

Politics and Academic Freedom. The involvement with defense research has lately been a subject of much controversy. Decisions to engage or terminate institutional technological projects frequently involve value judgments, even when the objective is not military. The definition of what is a political issue must be revised, both to protect academic freedom and to ensure that universities do not try to isolate themselves from the human consequences or the moral significance of their actions. This question can only be resolved—if then—in particular cases. The Institute community has a legitimate concern with and a right to a voice in matters involving relations between the Institute and external institutions. When questionable cases arise, those responsible for ap-

proving commitments of our institutional resources should discuss the issue with some group representative of the community before making a final decision. It may help if the Corporation invites the faculty to develop its views on the meaning and relevance of academic freedom to such decisions.

Academic institutions are exceedingly vulnerable to attacks of many kinds. There is no cure for this vulnerability, but we can at least recognize that to preserve the open atmosphere of the university we must try to protect both the right to dissent and the right of the university to function. We need to formulate a clear and simple statement of basic rights and responsibilities and to provide an effective judicial system for treating violations. We have a right to expect that if channels are provided for dissenting views to be aired, they will be used. We must look to the Corporation, as well as to our alumni and friends, to help protect the Institute from external attack.

Knowledge and Values

There is now underway a profound national effort aimed at transforming and renewing our national sense of purpose. This is an effort in which M.I.T. can and should take a leading role: first, by taking seriously the intellectual problem of defining the relation of knowledge to values; second, by improving our own performance as an environment for humane learning; and third, by stressing M.I.T.'s traditional commitment to public service and encouraging faculty and students to play an active role in the determination of public policy in areas of great social concern.

A critical issue lies at the basis of any consideration of the aims of education in modern times. That issue, simply put, is the relationship between knowledge and values. The rapid growth of science and technology, as Glenn Seaborg has said, is "bringing into direct confrontation what many men have tried to separate—fact from value." The reality of modern education is one in which the pursuit and application of scientific understanding is largely separate from the inquiry into human values and social goals.

This separation and conflict are especially important because of the high expectations that are today held, especially by students, of the social role of universities. M.I.T., as a major source of leadership in science and technology, has a special obligation to address itself to this problem.

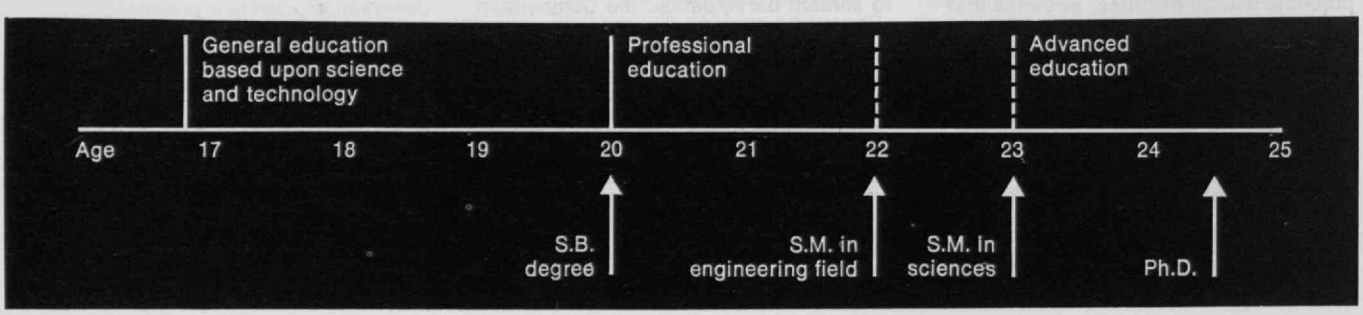
From an intellectual point of view, the problem presents itself in the paradox that the very success of science in freeing mankind from older fears and illusions may be engendering a new species of misunderstanding based on the idolization and misapplication of science. Other avenues of understanding are denigrated and in the debate over public issues vital but difficult issues of purpose are too often shunted aside in favor of narrow technical considerations and expert opinion.

Within the university, the separation of scientific activity from broader cultural and intellectual concerns has all but destroyed the capacity of academics to think of themselves as members of one common profession with shared intellectual and moral concerns. Problems that arise at the interfaces of the disciplines tend to be neglected or are considered too difficult to approach. M.I.T. can only hope to deal with this set of problems if it defines scientific competence to include a sense of the relationship of disciplinary specialties to each other and to the concerns of man and society. The development of new and broader interdisciplinary programs at the undergraduate and graduate levels will be a help in this effort. Further efforts must also be made, however, to encourage greater interchange between faculty in the humanities and sciences and to foster a continuing effort to define the goals that ought to be pursued in a scientific and technological age.

In practical terms, M.I.T. must face the question of why, after much effort, we have still not overcome the separation of the humanities and the sciences in the intellectual life of the Institute. It must be recognized that the current atmosphere of the Institute does not adequately encourage humane learning in the fullest sense of the term. Too many faculty members and students continue to think of the humanities, the social sciences, and the arts as unimportant, irrelevant, and methodologically "soft." The structure of the curriculum encourages students to relegate such studies to a minor, secondary role. Immense value is put on technical problem solving, as though this were all the Institute really cared about.

Part of the problem is that we need to do

In a modestly speculative excursion from the main thrust of its first report, members of the Commission on M.I.T. Education explored the effect on M.I.T.'s undergraduate program of adding a fifth (or even a sixth) year, by accepting students into M.I.T. at the end of their junior (or sophomore) years in high school. Obviously, the result is a fuller program of general education at M.I.T. "without infringing on the needs of disciplinary and professional education," and without repetition between high school and college work. Eventually the Commission's speculations came to focus on a three-year program of general education based upon science and technology leading to an S.B. degree in what the Commission calls the First Division of the Institute, followed by three years of professional work leading to the S.M.



much more to humanize our physical environment, which in many ways is brutally austere and ungraceful. But in the largest sense, we still have not succeeded in balancing our admirable efforts to inculcate a practical sense for doing science with the development of a better understanding of the philosophical and social dimensions of science and engineering—a concern that has been expressed by many of our forerunners at the Institute, from William Rogers to Henry Pritchett to Karl Compton. It is hardly enough to ask that this balance be accomplished by enhancing the impact of humanistic education at M.I.T. We must also encourage a broader view of learning and a deeper engagement with questions of value in the scientific and technical disciplines themselves.

The prevailing values at M.I.T. place a very great stress on productivity, efficiency, action, organization—to the detriment of more contemplative, casual, and spontaneous modes of intellectual life. Without losing the great virtues inherent in these values, we must do more than we have done so far to make room and time for reflectiveness. The busyness which is so characteristic of M.I.T. is not necessarily the most appropriate context for thoughtful reflection. Steps have already been taken to ease some of the work load and some of the tensions traditionally borne by M.I.T. students. Further steps should be considered.

We also need to consider ways of overcoming M.I.T.'s intellectual fragmentation. One possibility would be to experiment with small learning communities each with its own faculty and physical center. Another would be to arrange symposia on issues of general concern and to invite articulate commentators to discuss the issues with M.I.T. students and faculty in programs involving lectures, seminars, and informal conversation. If we expect to have any impact on the social and cultural problems which result from the fragmentation of knowledge, we ought to begin grappling with those problems here first.

At the same time, however, the Institute must not neglect its responsibility for promoting the humane use of science and technology in the larger society. M.I.T. has traditionally recognized public service as one of its leading concerns. Today, this concern must express itself in efforts to devote our resources to the solution of pressing social problems. Technology is only one component of many of these problems, but it is often a critical component. The idea that because science and technology have created many social problems, the way to solve those problems is to reject science is a patent fallacy—and a fallacy which ignores the extent to which science and technology have made enormous positive contributions to human and social progress. M.I.T. must continue to stand as an advocate of science as a value in itself, but it should also make whatever effort it can to explain the vital importance of science and technology to society. The Commission recommends that the Institute make a deliberate effort to identify areas of great social concern in which science and technology are critical elements and that it encourage faculty and students to play a meaningful role in the formulation and implementation of public policy in such areas as environmental pollution, the provision of better health care, and the solution of problems of the urban environment, including housing and transportation.

On the Agenda

The Commission has operated under a broad charge. In this report we have sought only to chart general objectives. We have certainly not dealt with all the important questions. Some of them can best be handled by other instrumentalities, such as the revised Committee on Educational Policy and the Institute Council we have proposed be established. Our aim has been to provide a framework in which specific problems and other issues of high priority can be addressed more effectively. The work of the Commission will not end with the release of this report. Further reports will be forthcoming from task forces whose investigations and deliberations have not yet been completed. In addition to producing these reports, we hope to be able to turn our attention to some of the fundamental questions that remain to be examined and to the implementation of the changes we have recommended, if these are adopted in principle.

Here we wish to single out a number of issues that in our view should be high on the agenda of future inquiries.

Institute Organization

M.I.T. has at this time an unparalleled opportunity to examine its internal structure. As we select a new President and consider the restructuring of the office of the President, it may be an appropriate time to consider other changes of organization as well.

1. As we seek a new dean for the School of Engineering, it would also be advisable to review the size and composition of the school.
2. The current divisions of function among the schools and the scope of their responsibilities could be reconsidered, especially in the light of the Commission's recommendation of an enhanced role for the schools.
3. The examination of the schools could also lead to a fruitful investigation of the current structure of the departments.
4. To establish a first division, as the Commission has proposed, we will need to develop adequate administrative and budgetary arrangements for handling this and other horizontal or orthogonal structures at M.I.T. The expansion of the health sciences and technology program will require a similar arrangement.
5. Serious consideration should be given to the planning and implementation of program budgets. Especially during a period of restricted funding, it is essential that the Institute develop a capacity to compare the quality and institutional style of various projects.

Educational Self-Regulation

1. The criteria for entering and leaving M.I.T.—admissions and degrees—need further examination.
2. Requirements for the S.B. degree, as well as grading systems, may need to be changed to accommodate the experimental program of the First Division. In particular, specific Institute subject requirements may need to be replaced by area credit.

Faculty Responsibilities

In proposing that the faculty take on increased responsibilities, notably in undergraduate education and in formulating policy for research and graduate education, the Commission is aware that many members of the faculty are already weighed down with many other responsibilities. The current range of faculty roles and responsibilities ought to be reexamined.

1. In particular, it may be necessary to take more formal account of actual teaching responsibilities, including supervision of graduate students and postdoctoral fellows.
2. The heavy involvement of M.I.T. faculty in research and consulting may stretch the span of responsibility too far. Further limitations in addition to those already in force may need to be considered.
3. We also need to consider ways of cutting back or eliminating the routine procedures which waste valuable faculty time (including much of the red tape in grant applications, reporting, etc.).
4. The responsibility of faculty members to the Institute needs to be better defined. At the same time, we also need to review the conditions and guarantees the Institute provides for its faculty, including academic freedom and tenure, as well as salaries and benefits. The guarantee of academic freedom needs to be explained better. Tenure policies need to be reexamined carefully and imaginatively, especially in view of funding constraints and the desirability of a continuous renewal of faculty creativity.

Community Relations

Another major issue which the Commission has only touched upon is community relations. The Institute has already begun to reconsider certain of its procedures and policies with the aim of promoting better understanding between M.I.T. and the Cambridge community and of devoting some of its resources to critical problems facing Massachusetts and the New England region. A more thorough consideration of this issue than has so far been mounted is certainly needed.

Alumni Correspondence

Alumni in the Presidency

To the Editor:
In the July/August issue, you wrote that James R. Killian, Jr., '26, was "the first alumnus to lead the Institute" (*p. 84*). But sometime in the early part of the century, one of Tech's very capable alumni, one Professor Arthur Amos Noyes, was Acting President; he gave up this post because he was not in tune with the type of responsibilities that a president had to contend with. I do not believe that Dr. Noyes was inaugurated in the strict sense of the word, but he was certainly an alumnus who was the leader of the Institute for a short period.

(Dr. Noyes was a boyhood friend of my father's, and I myself visited with Dr. Noyes once or twice, when he returned to Tech having gone to the West Coast to become associated with Cal Tech.)

John W. Clarkson, '18
Concord, Mass.

Mr. Clarkson is entirely correct, and the Editor bows to his flawless memory. Dr. Noyes was Acting President of the Institute from June 30, 1907, to June 7, 1909; he studied chemistry at M.I.T. with the Class of 1886.—Ed.

Behind the Present

To the Editor:
The only history of M.I.T. presently available is *When M.I.T. Was Boston Tech,* in which Samuel C. Prescott ('94) covered the early years of M.I.T.'s history up until the 1916 move from Boston to Cambridge. Needless to say, in the last 50 years, there has been a great change in M.I.T.'s work, purpose, background, and objectives. Yet today a large part of this background of work and objectives is more or less unknown because it has not yet been set down in definitive form for others to consider.

Professor Walter A. Rosenblith commented at a recent Alumni Officers' Conference in San Francisco that even today there are probably less than 150 members of the M.I.T. faculty who intimately remember the administration of Karl T. Compton during the 1930's. Probably even fewer remember the previous administrations of Samuel W. Stratton and Richard C. Maclaurin. Yet, it is exactly this background and this history which most need to be discussed, recorded and brought into focus.

As a Harvard Law School alumnus, I cannot help but think of the recent excellent publication by the Harvard University Press of *The Law at Harvard, a History of Ideas and Men, 1817-1967,* covering the history and background of the Harvard Law School. While such a publication must necessarily be a labor of love in large part, nevertheless, there must be many who love M.I.T. as much as those who love Harvard Law School and might be commissioned to write such a book!

It is my sincere hope that *Technology Review* may be the catalyst for effective action in undertaking to sponsor publication of the definitive history of M.I.T., picking up where *When M.I.T. Was Boston Tech* left off.

Henry F. Lippitt, 2nd, '36
Los Angeles, Calif.

On Alumni Leadership (cont.)

To the Editor:
Stanley Proctor's letter to *Technology Review (July/August, page 108)* makes a two-fold argument: 1. In the past, there has been a certain route one follows if one aspires to national alumni office. An analogy to boy scouting is appropriate: the cub scout is the younger, poorer, less experienced alumnus, low in status in his corporate hierarchy; if he is good (contributes his time), he moves up to the boy scout level, where he can begin to *earn* merit badges (organize dinners, lectures, local fund drives, donations of substantial money) and aspire to regional office. As an explorer scout, the alumnus is out of regional politics as well as middle management; now he can speak at the dinners organized by others; now he gives the lectures and donates the large sums of money; and now (gasp) he can aspire to national office. 2. As it was in the past, so it shall be in the future.

A related set of questions that must be asked is, How is a given set of experiences related to being a good officer of the Alumni Association? As I recall, very few if any of the last nominating slate were academics. Why? Is it because being a professor is not a good experience? Does it not prepare one for the exalted post of national alumni officer? Or is it simply that being an academic is good experience? If Mr. Proctor wishes to use "experience" as a qualification, he is obliged to state why that experience is valuable *and* to expect challenges to his criteria. The experience to which Mr. Proctor alluded was akin to the experience of being "hazed" as a fraternity pledge—good only for making you "part of the club."

Let me go one step further. It just may be that having "experience" in working in the American society during the past 30 or more years is reason *in itself* for being disqualified from managing affairs in the next 20 or 30 years. However, one does not have to take this position to doubt the value of the "experience" to which Mr. Proctor alludes in being a member of the national M.I.T. Alumni Association. The world moves on . . .

Mr. Proctor begins his third paragraph by misunderstanding the main point of the criticism of current procedure. We do indeed know and understand how alumni officers are chosen. That is precisely what we are objecting to. We need neither Mr. Proctor's contemptuous explanations of the obvious nor his gratuitous comments on the side.

Michael R. Leavitt, '66
Chicago, Ill.

Institute Review

Faculty Self-Discipline

The Staff Section of the Staff-Administration Committee has proposed, and the faculty has approved, a two-stage procedure for inquiry into and (if necessary) judgment of alleged actions of academic staff members participating in the occupation of the offices of the President and Chairman of the Corporation on January 15 and 16, 1970 (*see* Technology Review *for February, 1970, pp. 72A-72D*).

Last January's occupation was without precedent at M.I.T., so there are no standing Institute policies which the Staff Section deemed "sufficient to ensure due process" in the case. Hence the Section's decision to develop and obtain approval of *ad hoc* procedures, drawing heavily on recommendations of the American Association of University Professors and the American Association of Law Schools.

The two stages involve:

1. A Committee on Inquiry, to investigate the alleged involvement of staff members and the events themselves to determine if there is "clear and convincing evidence" that the actions were in fact "sanctionable"; and to formulate charges to be preferred, if any.

2. A Hearing Committee, to determine "whether actions alleged in the charges are sanctionable and whether individuals named acted as so charged," and to recommend sanctions.

The Hearing Committee will report its findings and recommendations to the President for transmittal to the Corporation.

The Committee on Inquiry is specified to consist of the Staff Sections of the Staff-Administration Committee for the years 1969-70 and 1970-71, appointed by the Chairman of the Faculty. The Hearing Committee is to be nine members of the academic staff—four full professors, two associate professors, two assistant professors, and one instructor—selected on a "random" basis and appointed by the Chairman of the Faculty or his delegate.

James A. Fay, Chairman of the Staff Section of the Staff-Administration Committee in 1969-70, emphasized to the faculty that because there is no written faculty rule or code of conduct anticipating actions such as those alleged, "only the existence of a clearly accepted common law can provide a basis for sanctions." Hence the dual assignment for the Committee on Inquiry: to weigh evidence on the question of the offense having been committed *and* on its incompatibility with the responsibilities of an academic appointment.

The process of faculty self-discipline was initiated in April, 1970, following disposition of trespass charges in the courts, when President Howard W. Johnson asked the Staff Section to consider how the alleged actions "may be inquired into and judged whether and to what extent they are to be deemed unacceptable in this institution."

President Johnson made his own position clear in radio interview with Paul E. Schindler, Jr., '74, broadcast late this fall on WTBS: The occupation of the office was an event "saddening and defeating for the concept of a community of scholars, of teachers and students trying to learn," he said. "I look upon that incident as a disruption of the Institute process that needs some kind of review."

The Radical Motive

Don't be put off by excess noise and other superficialities. When you look at an educational institution today the real question to ask is about the quality of education, and the quality of the students, Howard W. Johnson, President of M.I.T., told more than 40 members of the M.I.T. Class of 1922 at M.I.T. late this fall. *(Photo below: James R. Killian, Jr., '26, Chairman of the Corporation, speaking)*

It was an unusual meeting, planned by the Class Officers because of the unusual interest of their classmates in M.I.T. affairs—and their generous contributions to M.I.T.'s excellence over the past half-century.

"Every university in the country," President Johnson said, "is today exposed to violence from a group that would like to cast doubt on our greatest institutions. The name of the game in the radical movement is to disenchant us with our sources of strength.

"If you buy their line they will have won," he said.

A Historic Bond Issue for M.I.T. Construction

Three major new construction projects at M.I.T.—Westgate II student housing, heating plant expansion, and new facilities in the chilled water plant—have been financed by a $10,500,000 construction bond issue released on November 12, 1970. It was the first issue through the Massachusetts Health and Educational Facilities Authority on behalf of a private educational institution.

After competitive bidding, the bonds were placed with an underwriting syndicate managed by Goldman Sachs and Co. and Morgan Guaranty Trust Co. of New York; other participants included Bear Stearns and Co., Hornblower and Weeks-Hemphill Noyes, Paine Webber

Jackson and Curtis, L. F. Rothschild and Co., and Van Kampen Wanterlech and Brown. The net interest cost to M.I.T. was just over 6.37 per cent, a portion of which will be reimbursed by federal funds.

Interest and principal on the 40-year tax-exempt bonds will be met by income from rents, in the case of Westgate II, and charges against activities using buildings benefiting from the new utilities, in the case of the heating and chilled water plants. The bond issue was prompted by a new form of assistance available under the College Housing Loan Program of the U.S. Department of Housing and Urban Development. In the past, college housing loans at low rates of interest have been issued directly to schools, including M.I.T., to pay for construction. Under the new program, according to Laurence H. Bishoff, '59, Assistant to the Vice-President—Operations at M.I.T., institutions may obtain private loans for construction of educational facilities of all kinds, and the Department issues debt service subsidy grants annually for the life of the bonds, to lower the institutions' loan cost. The bonds issued under M.H.E.F.A. are tax-exempt.

A New Take-Off Point after 50 Years of Chemical Engineering

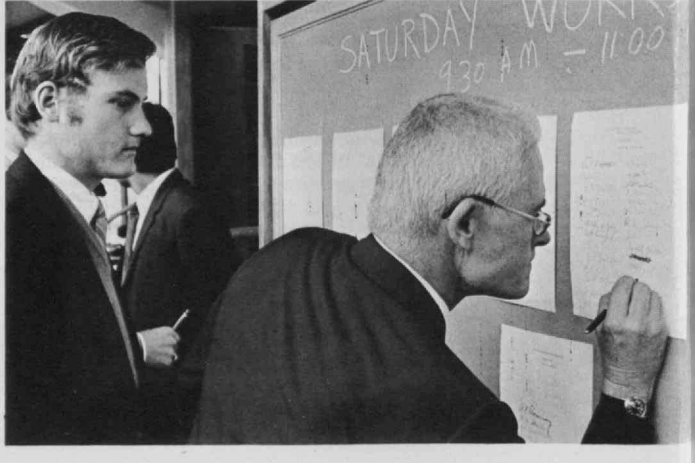
Chemical engineering has reached its 50th anniversary at M.I.T., but when more than 200 of the Department's most distinguished alumni gathered in Cambridge to celebrate the event on October 23 and 24, President Howard W. Johnson told them that "the decade of the 1970's clearly represents a take-off condition" for their profession.

"The powerful urge to apply science and engineering to the solution of the pressing problems of our time puts a premium on chemical technology as one of the branches of engineering that is closely coupled to society's needs," President Johnson said in opening the Half-Century Convocation. He described "three catalytic developments which will have much to say about the future of chemical engineering":

◇ The development of new materials—and of more efficient ways to make existing materials. Synthetic materials—plastics, rubbers, textiles, and building materials—are now a $60 billion U.S. industry; sales will rise to $130 billion by 1980.

◇ What Mr. Johnson called "a revolution in the field of health care" resulting from the "systematic application of advanced technologies." He cited rapidly increasing knowledge of the complex processes of living organisms—and the consequent opportunity to control such processes and to apply their principles to industrial problems; and he mentioned especially the plans of M.I.T. and the Harvard Medical School to bring engineering and medicine together "in a new partnership which we believe will have

When alumni of M.I.T.'s Department of Chemical Engineering—the first in the nation—celebrated its 50th anniversary in Cambridge this fall, the center of the stage was held by Warren K. Lewis, '05 (top, left), whose arrival precipitated a standing ovation (top, right) which interrupted the address by President Howard W. Johnson. Raymond F. Baddour, Sc.D. '51, Head of the Department of Chemical Engineering, presided at luncheon (center, left); Robert C. Gunness, Sc.D.'36, paid tribute to Edwin R. Gilliland, Sc.D.'33, a former Head of the Department (center, right); and there were ample opportunities for corridor reunions as well as professional renewal in departmental workshops.
(Photos: Ivan Massar, Black Star)



a profoundly important effect on the future development of medicine, medical education, and the life sciences."

◇ The growing emphasis on issues of environmental quality throughout the U.S. Chemical engineers have a central contribution to make through their knowledge of water and air purification, large-scale chemical reactions, and the management of many exotic new materials.

So Great It's in Trouble?

When the Department of Chemical Engineering called its alumni back to celebrate its 50th anniversary (*see above*), the guest list read like a who's who of the profession; there were 21 company presidents, 36 vice-presidents, 22 technical directors and managers, and 12 senior engineers and scientists. It was, as Ralph Landau, Sc.D.'41 (one of the presidents—of Halcon International, Inc.) pointed out, an opportunity to see "the evolution of a profession literally before our very eyes and in our own lifetimes."

The history belonged to Warren K. Lewis, '05, Emeritus Professor of Chemical Engineering who received a standing ovation when Mr. Landau, Chairman of the Sponsoring Committee for the Convocation, introduced him as "the most famous chemical engineer in the world."

Professor Lewis in his turn credited the Department's greatness to the faculty's policy of basing chemical engineering education in chemistry, "training the student so that he has the capacity when faced with a new and unfamiliar situation to find the answers."

The tradition continues; at luncheon on Friday noon, John Ross, Head of the Department of Chemistry—admitting that "some of my best friends are chemical engineers"—noted that "the esoteric subject of today may be the economic bonanza of tomorrow. No one knows how to predict," he said.

As for the present, Raymond F. Baddour, ScD.'51, Head of the Department of Chemical Engineering, said M.I.T.'s role in the profession must grow. Enrollment can be increased by 50 per cent, he said, without a significant change in the cost or quality of education. Already there has been in the current academic year a 50 per cent increase in sophomores and in graduate students registered in the Department, but it is clear that the demands for chemical engineers will be greater than the supply throughout the 1970's.

Though Professor Baddour insisted that "you really have to want to be a chemical engineer to work as hard as our students have to," a panel of chemical engineering undergraduate and graduate students in the afternoon spoke almost entirely of their extra curricular interests. Indeed, their response to the professional challenges which Professor Baddour, President Johnson, and several alumni had earlier described was so passive that Richard I. Bergman, '55, Vice-President of Systemedics, Inc., began to wonder what was wrong. "Controversy is a proper part of the learning experience," he told the students during a discussion session. "What about pollution and population? Are you worrying about the black water in the Penobscot River? Is there really some innovative thinking here?

"When you meet an entrepreneur and he says he's great, you know he's in trouble," warned Mr. Bergman.

Four living heads of the Department of Chemical Engineering were honored at the convocation dinner when each received a piece of the worn stone of the Institute's Massachusetts Avenue entrance over which so many of their students had stepped. Robert C. Gunness, Sc.D.'36, President of Standard Oil Co. (Indiana) paid tribute to Edwin R. Gilliland, Sc.D.'33, who was Head from 1960 to 1968, as "a continuous, constructive and powerful influence on chemical engineering." Walter G. Whitman, '17, Head from 1934 to 1960, held the "unique conception that it was the student's business to get out of the Institute and get a job," said Mr. Landau. When he presented a stone fragment to Professor Baddour, John F. O'Donnell, '55, President of Abcor, Inc., remarked on Professor Baddour's "ability to live gracefully with things that cannot be altered."

A professional session of the convocation was devoted to issues in the future of the chemical industry, and there were workshops on problems of current interest in which alumni quite literally returned to the Chemical Engineering classrooms. As the sessions ended, Hoyt C. Hottel, S.M.'24, Professor of Chemical Engineering, Emeritus, told the alumni that he was "tremendously impressed by the warmth of feeling here." Speaking for the faculty, he said, "We need contacts like this; the convocation was a bigger lift to us teachers than to you who want to be reminded of 'the old days.' "

Lecturer on National Health

Dr. David D. Rutstein, Ridley Watts Professor of Preventive Medicine at Harvard Medical School, has been appointed Visiting Institute Lecturer at M.I.T. for the current year. In making the announcement, Jerome B. Wiesner, Provost, noted that the title of Institute Lecturer is one rarely granted at M.I.T., its connotation being that of a person whose ideas are likely to have an impact on the Institute community at large rather than on a single department or school.

As Institute Lecturer, Dr. Rutstein will deliver a series of topics which he describes as being "directed towards the definition of the professional standards, scientific criteria, and the organization of a United States national health and medical care program." The series is a sequel to an earlier group of lectures, "The Medicine of the Future," given in 1966 and published by the M.I.T. Press in 1967. They are also directly relevant to Dr. Rutstein's recent book in co-authorship with Professor Murray Eden of M.I.T.'s Department of Electrical Engineering, *Engineering and Living Systems.*

Walter Humphreys, 1874-1970

Walter Humphreys, '97, a member of the M.I.T. Corporation for 47 years and its Secretary for 31 years, died on October 14, 1970, at the age of 96. He was Editor of *Technology Review* from 1899 to 1907 and Secretary-Treasurer of the Alumni Association from 1906 to 1923.

Mr. Humphreys studied mechanical engineering at M.I.T., and he returned to teaching in that field in 1907, becoming Associate Professor in 1922; he served concurrently as Registrar of M.I.T. from 1902 to 1922. Mr. Humphreys' first appointment to the Corporation was in 1923; he became a Life Member and Secretary in 1929, assignments in which he continued until retirement (to Emeritus status) in 1960. Meanwhile, he was Secretary-Treasurer of the National Association of Wool Manufacturers from 1922 until his retirement in 1952.

Mr. Humphreys was active in civic and local educational affairs as a trustee of the Boston Museum of Fine Arts and Brookline Public Library, a director of the Harvard Cooperative Society, and a member and Chairman of the Brookline School Committee. He was an Honorary Member of the Alumni Advisory Council, and he filled a number of assignments on standing and visiting committees of the M.I.T. Corporation in addition to long-time service as Secretary; his signature as Secretary is on countless M.I.T. diplomas.

New York Music Festival

Three concerts by the M.I.T. Glee Club and the choir of Douglass College, the M.I.T. Symphony Orchestra, and the M.I.T. Chamber Music Group on March 30, April 19, and May 11 are being planned as a New York Music Festival in tribute to Dr. and Mrs. James R. Killian, Jr., '26, on the occasion of Dr. Killian's retirement.

The Symphony Orchestra concert will be preceded by a reception for Dr. and Mrs. Killian and a buffet supper in the Grand Ballroom of the Park Sheraton Hotel; and the other concerts will each be followed by receptions for the performers. Further details and reservations are available from the M.I.T. Alumni Center of New York, Room 1828, 295 Madison Avenue, New York, N.Y., 10017.

Students and Elections: Pay Dirt

"Thar's gold in them thar hills!"

That's what people said, anyway, last May, when thousands of students signed petitions, letters, and telegrams to their representatives protesting the invasion of Cambodia and the shooting of four students at Kent State University. Rosy predictions were made of how students' attitudes all over the country had changed as a result of these events—instead of sitting by while a small group of radicals made headlines—students had decided to turn themselves into active political resources and work for peace candidates in the fall.

But came the reckoning—or rather the campaigning—and the digging was harder for many organizations trying to transform a May signature into an earnest, hard-working, September campaigner. The results weren't exactly golden.

The Movement for a New Congress, which had collected 100,000 signatures in May (*see* Technology Review *for October/November, 1970, pp. 105-106),* got a total of 2,000 volunteers in New England who worked at *some* point between May and November 3. Robert A. Schaeffer, '69, M.N.C. New England head, says the group once estimated it could turn out five times that number.

M.N.C.'s experience is similar to that of other student recruiting groups and of candidates who wanted student help. Father Robert Drinan, New England's most prominent "peace" candidate, used students extensively in his campaign for the U.S. House of Representatives, and he scored a spectacular upset, ousting veteran Representative Philip Philbin in the primary and then defeating a "liberal-suburban" Republican. Elaine Handy, his 22-year old student coordinator, a graduate of St. Regis College in Weston, said that the 1,140 students who worked for Drinan were far fewer than expected. Typically, a college which had signed up 150 students in May produced possibly 10 workers in the fall, she said.

Youth Were Candidates, Too

But these gloomy figures—as well as the dire newspaper headlines which pronounced the "failure" of the student political effort—are in many ways misleading.

For one thing, the student volunteer turnout nationally was larger than ever before. Compared with the last election in which students figured, the 1968 Presidential primary (when only a few students, on a national basis, worked for Eugene McCarthy and Robert Kennedy), this year's figures were large. The numbers of student volunteers in the 1970 campaigns of even conservative candidates such as James Buckley in New York (he claimed 6,000) compares rather well with the numbers of adults who appeared to work for candidates.

Another development was the use of students as members of candidates' full-time staffs. Father Drinan's 60-member full-time staff was two-thirds student—and the eldest of the whole group was a 29-year-old campaign manager. (The youngest staffer was a 13-year-old receptionist, who, in 1968, worked for McCarthy!) Of the 60, only three or four were paid for their time, which ran usually about 80 hours per week, says Miss Handy.

Another plus was the number of youth candidates who ran this year for office. In Cambridge, which is different anyway, every few years a Harvard student or ex-student runs for City Council or some such post. But this year, in eastern Massachusetts alone there were 20 contests with serious primary candidates in the 25-year-old age bracket, and a fair number of other, less "serious" ones. Some of these even won. Miss Handy feels voters will see more and more student candidates in the future.

Although nothing like the 400,000 students who under the "Princeton Plan" could have used their time off to campaign in the weeks prior to the election did so, nobody has any sure way of computing the number who did use the time for this purpose.

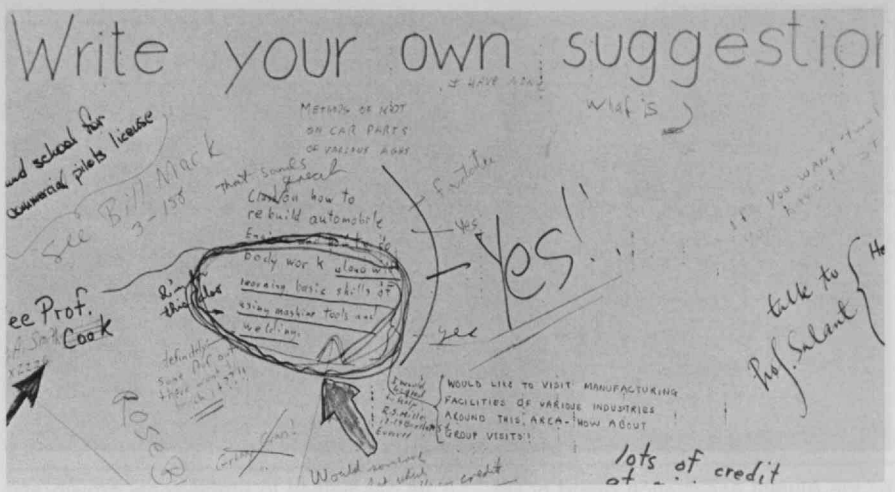
M.I.T. was one of 25 schools across the country which voted in May to have such a calendar break just before the election time so that students could work for candidates. And, as in most places, no one in Cambridge is sure how many students used the week-long break to actually work for political goals. But it may be significant that no one has yet announced the death of the "Princeton Plan"; indeed, educators at M.I.T. and elsewhere seem to be proposing that this become a permanent calendar break—a fall-term vacation to complement the traditional spring vacation.

"We Want To Be Ready Next Time"

But the fact remains that student help was less than a pot of gold. The reasons? "I think it was just general apathy. Also, there was no big climactic thing to bring up the storm of emotion that turned out the students in May." Neither Miss Handy nor Mr. Schaeffer set much store by the theory that students were discouraged from working because of the heated words on campus unrest which loomed so large during the campaigns. Mr. Schaeffer's view: "It's the reverse of a revolution of rising expectations. To many students, all the alternatives seem to lead downhill. So you don't get out and work for a candidate; instead you study—you feather your own nest.

"I'd bet that the number of course hours for which students have registered this fall are up. All my friends have committed themselves very heavily academically this term."

So what of the war-weary campaigners? Miss Handy herself plans to go skiing, although she adds hastily "I think its irresponsible." Then she'll work (this time for a minimal salary) for a group investigating unfair realty practices in Chicago before entering a law school next September. Mr. Schaeffer has been working on a survey for the Twentieth Century Fund on the impact of students on election campaigns. He thinks that M.N.C. wasn't well enough organized last May to take advantage of the situation and recruit effectively. "We want to be ready next time," he says.—D.S.



The Department of Mechanical Engineering asked students to write their own suggestions of what they wanted to do during the experimental "independent activity period" in January. The result was this boardful of suggestions—and the same thing was happening throughout the Institute. It will be a busy month.

Independent Activities: No Holiday in January

A cruise to the Barbados? Or how about a short course and workshop in "the nuts and bolts of urban planning"? Or a series of oceanographic cruises aboard the *Robert R. Shrock* in Boston Harbor?

When the faculty voted last spring for a new academic calendar for 1970-71 in which the first-term finals were to be finished before Christmas, a one-month "independent activity period" in January, 1971, was an important corollary. It was to be a chance for students to follow special interests, taking work at M.I.T. or elsewhere which would not otherwise be available to them, or simply to take mid-winter vacations on ski slopes and tropic beaches.

But as January approached, the wealth of alternatives on the campus suggested a mini-recession in the tourist trade.

The prize for the most exotic proposal clearly goes to Henry M. Stommel, Professor of Oceanography, who has announced "a very limited opportunity" for a few graduate students to join *R. V. Knorr* on an oceanographic cruise from the Woods Hole Oceanographic Institution to Barbados or Puerto Rico to study Gulf Stream microstructures. To go, he says, students must "convince us that they can be of real help preparing cables, rigging things on deck, operating winches, or repairing electronics." A further warning: while the ship is on station in the Anegada Passage, there will be "constant puttering about with gear over the side," and the "general atmosphere will be similar to that aboard a stranded bus whose occupants must spend five days trying to get the engine to run—in the rain."

Dr. Carl I. Wunsch, '62, Associate Professor of Oceanography, will conduct a four-week seminar in January on equatorial dynamics, and two or three of his students will probably be able to join the Aries Expedition—an oceanographic cruise from Tahiti to Hawaii during April to study equatorial undercurrents, of which M.I.T. is co-sponsor.

Almost every department plans such special lectures and seminar series. The Department of Urban Studies and Planning will group its program into a short course on "the nuts and bolts of urban planning," including transportation, computer applications, grantsmanship, taxation, zoning law, and population forecasting. In addition, the Department proposes that undergraduates may want to visit other institutions where planning is taught, and Lawrence E. Susskind, Instructor in Urban Studies, says that "we hope to utilize the field of reports of such students in building our own program."

Opportunities for undergraduates and graduate students to participate in ongoing research in January will be legion. Weather radar; computer-aided design; lunar surface studies (radar); transportation systems, vehicles, and safety; behavior of materials; long-range weather forecasting; and information systems are among the items in a very long list. The Sloan School of Management will offer an intensive one-week sensitivity training program. The Athletic Department will give two-hour-long classes in scuba diving and skiing (weather permitting). The Department of Humanities will conduct a workshop in four-hand piano music, and Joseph D. Everingham, Professor of Literature who is Director of Drama, will conduct a workshop theater course in staging and producing "The Merchant of Venice." Giancarlo de Carlo, Bemis Visiting Professor of Architecture, will join students on a research program in university planning.

Or how about a seminar on Formula V racing car design and development, proposed for the Department of Aeronautics and Astronautics by Professor E. Eugene Larrabee? Or, if you're taking the Electrical Engineering Department's basic (sophomore) course in Circuits, Signals, and Systems, how about a series of lectures and seminars ("informal group study with a large amount of instruction-student contact") on random variable processes, or on state variable concepts?

S.D.S. and the Faculty Club

The marriage of labor and radicals—so long hypothesized by the S.D.S. and disdained by campus workers—was finally consummated by three black employees of the M.I.T. Faculty Club this fall. The results were a series of small-scale pickets by S.D.S. members; a confrontation between members of M.I.T.'s Black Student Union and Faculty Club (and Institute) officials; an abundance of rhetoric and misinformation; and estrangement between employees, their union representatives, and the Faculty Club management, which rendered more difficult any equitable settlement.

The issues appeared late in October, when the three employees, S.D.S., and University Action Group (a new coalition of radical faculty and graduate students) joined in a rally to charge the Faculty Club with "racist exploitation" of the workers; the Manager of the Faculty Club was named for "harrassment" of them; and S.D.S. then extended the argument by claiming "intolerable" working conditions and discrimination against minority employees throughout M.I.T.

Challenged by S.D.S. to support minority rights, members of M.I.T.'s Black Student Union entered the hassle on November 17, when they appeared in the Faculty Club quarters an hour before the scheduled start of a "wild west" party to demand its cancellation. They left two hours later after constructive discussions between students and Faculty Club and Institute officials; but the party was cancelled, and the students face internal disciplinary review for disrupting it.

By mid-December the wage and working conditions issues had been negotiated between the Faculty Club, the Building Service Employees International Union, and the employees—who were still on duty at the Faculty Club. And the S.D.S. was still "fighting racism" with noisy pressure for "equal pay for equal work" —and for amnesty for B.S.U. members. Though awareness was surely increased, the issue of possible discrimination in M.I.T. personnel policies and programs had not taken root as a point of wide community concern.

The Alumni Association's highest honor for service to M.I.T. was given to these six men attending the 1970 Alumni Officers' Conference: (left to right) Raymond Stevens, '17; Edwin D. Ryer, '20; James Donovan, '28; F. Richard Meyer III, '42; Angus N. MacDonald, '46; and Robert R. Shrock.

Seven Bronze Beavers and 100 Certificates for Services

Seven Bronze Beavers, the highest awards given for service to M.I.T. through the M.I.T. Alumni Association, were presented during the 1970 Alumni Officers' Conference on October 16, and nearly 100 other alumni were given certificates for achievements for the Alumni Fund and *Technology Review* during the 1969-1970 year.

In addition, 39 alumni who were members of committees which sponsored seminars on "How to Start and Operate a Small Business" in five cities in 1969-70 shared in the 1970 Presidential Citation.

The Bronze Beaver recipients were:

◇ The late Avery A. Ashdown ('24), Associate Professor of Chemistry, Emeritus, for "successfully involving thousands of students and alumni in M.I.T. affairs . . . as the personification of loyalty and interest in M.I.T. in the eyes of his many friends." (Professor Ashdown died on July 15, after the award had been voted by the Alumni Association Board of Directors but before it could be presented to him.)

◇ James Donovan, '28, who "has assumed numerous leadership roles in virtually every area of alumni activity, (including) developing the extraordinary interest and loyalty to M.I.T. by his Class of 1928."

◇ Angus N. MacDonald, '46, "for many years a leader of alumni activities in the New York area," who has been instrumental in supporting M.I.T.'s activities in music and art.

◇ F. Richard Meyer III, '42, "Mr. M.I.T. of Chicago," who has brought "thoughtful and valuable advice to bear on important alumni issues at M.I.T."

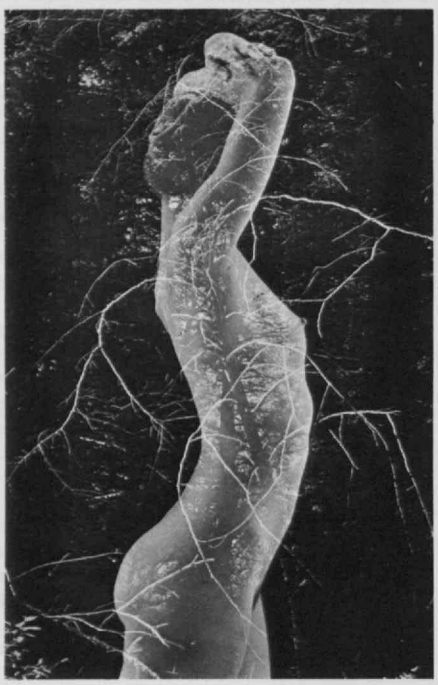
◇ Edwin D. Ryer, '20, for "his lifelong concern for the students, alumni, classmates, and the general welfare of M.I.T."

◇ Robert R. Shrock, Professor and Head of the Department of Geology and Geophysics, for "outstanding contributions to the hundreds of alumni whom he has helped in professional growth and interest and loyalty to M.I.T., through his kindly influence and his exemplary personal attitudes."

◇ Raymond Stevens, '17, "a devoted alumnus for over five decades" who has "enthusiastically performed a wide variety of assignments for the Institute, Alumni Association, and his Class of 1917" which in total exceed 175 years of service.

Technology Review's editors honored with special certificates 10 Class Secretaries who have contributed reports to the *Reveiw* for 25 years or more: Harold Bugbee, '20, Carole A. Clarke, '21, Herbert S. Cleverdon, '10, F. Leroy Foster, '25, Fred W. Goldthwait, '05, Joseph S. Harris, '27, Henry B. Kane, '24, Azel W. Mack, '15, Burton G. Philbrick, '02, and Eugene R. Smoley, '19. In addition, the *Review* cited 34 Class Secretaries who had provided reports for every issue of Volume 72.

Eight retiring members of the Alumni Fund Board received certificate awards of the Alumni Fund: Philip L. Coleman, '23, Wayne J. Holman, Jr., '39, Sterling H. Ivison, Jr., '41, Dean L. Jacoby, '54, Samuel E. Lunden, '21, Denman K. McNear, '48, Thomas F. Morrow, '35, and Leonard F. Newton, '49. There was a special award for Donald L. Arenson as Chairman of the Parents' Fund for 1969-70, and there were certificate awards for 28 Class Agents, six Course Agents, and 47 area Leadership Chairmen.



An exhibition called "Be-ing Without Clothes" filled M.I.T.'s Hayden Gallery with pictures—and people—throughout November; its 129 photographs resulted when Minor White, Professor of Photography, two years ago asked a number of his students and other photographers to turn their cameras to the theme, "to 'search out the livingness' discovered in the presence of unclothed family, friends, and models." The exhibition is a selection from over 1,100 photographs received.

C. R. Wasserman, reviewing the exhibition for the Boston Globe, *commented on the diversity and the "fairly high" quality of the images; but he said the "sense of wonder at the various manifestations of the human body in its humanness" made it "one of the most important shows this year."*

New Enterprise Workshops

Building on the success of 1969-70 seminars for would-be entrepreneurs, the M.I.T. Alumni Association will offer workshops on "Managing a New Enterprise in Today's Economy" in five principal cities—Boston, Chicago, New York, San Francisco, and Washington, D.C.—during the first months of 1971.

The workshops will emphasize problems of entering into business and staying in business under present economic conditions. Sessions at each will be devoted to finance, marketing and product development, production, accounting and

Managing a New Enterprise in Today's Economy

Registrations are still available for this new Entrepreneurship Workshop Series.

The program will be given in Boston, New York, Washington, D.C., Chicago, and San Francisco. For more information and registration, please call:

Boston: Alumni Association	(617) 864-6900 Ext. 3768
New York: Alumni Center	(212) 532-8181
Washington, D. C.:	
Loughrey R. Kuhn, '67	(202) 223-4030 (Business)
	(202) 833-1575 (Home)
Chicago: Austin R. Baer, '35	(312) 656-9300 (Business)
	(312) 834-8284 (Home)
San Francisco:	
Martin R. Wank, GM'58	(415) 961-1650 (Business)
	(415) 948-6582 (Home)

control, attracting and holding staff, managerial style, and law; most speakers will be businessmen who report from personal experience.

For details of dates, places, and programs, alumni are advised to write to Panos D. Spiliakos, '66, Assistant Secretary of the Alumni Association, Room E19-438, M.I.T.

Alumni Calendar

Baton Rouge—January 19, 1971, Tuesday—Meeting. Speaker: Paul E. Gray, Dean of the School of Engineering.

Columbus—January 18, 1971, Monday—Meeting. Speaker: Paul E. Gray, Dean of the School of Engineering.

Dayton—January 5, Tuesday—Dinner meeting, Dayton Country Club, 555 Kramer Rd. Alumni getting to know undergraduates.

Los Angeles—January 26, 1971, Tuesday. 6:30 p.m.—Dinner meeting, Beverly Hilton Hotel. Remarks by Howard W. Johnson, President, followed by a discussion dialogue about the Institute.

Club Notes

The 23rd annual M.I.T. Fiesta in Mexico, March 11 through 13, 1971, will honor Dr. and Mrs. James R. Killian, Jr. ('26), in the year of Dr. Killian's retirement as Chairman of the M.I.T. Corporation.

Members of the M.I.T. Club of Mexico City are arranging the usual gala occasion, including visits to the Anahuacalli Museum, the Bazaar del Sababo, and other attractions in Mexico City as well as a day trip to Xochicalco Pyramid, Cuernavaca, the Palacio de Cortes, and Jardines Borda. The Fiesta will close with the traditional Noche Mexicana on Saturday, March 13, Dr. Killian will speak at luncheon on March 11.

Further information is available from M.I.T. Club of Mexico City, Reforma 116-804, Mexico 6, D.F.

About 75 members and guests of the M.I.T. Club of Northern New Jersey attended the October 28, 1970, dinner meeting at the Orange Lawn Tennis Club, South Orange, N.J., to hear William C. Borland, Engineer of Logistics and Materials, describe the vast World Trade Center being built in lower Manhattan by the Port of New York Authority. The north tower of the identical pair which will dominate the New York skyline, had just been topped out at its 110th story and 1,350-foot height to break the altitude record held by the Empire State Building for the last 40 years.

The towers and the associated low-rise buildings, covering 16 acres, will house 50,000 people when fully completed in 1973. Included are a U.S. Custom House, a hotel and various sub-level parking areas.

Club President Edwin C. Baker, '56, announced the next event as a tour of the restored private residence of Thomas A. Edison, now a national shrine under the care of the U.S. Department of the Interior. On January 12 there will be a dinner meeting in Summit, N.J., addressed by a U.S. attorney in charge of the Federal Anti-crime Strike Force in New Jersey.

Electronic data processing and management—with the emphasis on "mini-computers"—will be the subject of a one-day symposium of the M.I.T. Alumni Center of New York on January 16.

Following a morning session on interactive computing systems conducted by Thomas P. Gerrity, Jr., '63, Assistant Professor of Management of M.I.T., the afternoon will be devoted to a general discussion of the "mini-computer" and the reasons for its current popularity. Charles P. Lecht, President of Advanced Computer Technology Corporation Corp., will be luncheon speaker; his topic: "Export Your Data-Processing Headaches."

The all-day program, beginning at 9 a.m., will be held at the Education Center of Inter-Act Corp. in the Burlington Building, 1345 Avenue of the Americas. The $50 fee covers luncheon; reservations and further information are available from the M.I.T. Alumni Center of New York, 295 Madison Avenue.

Deceased

Walter Humphreys, '97, October 14, 1970
Harold A. Everett, '02, October 7, 1970*
Louis B. Rapp, '03, August 31, 1970
George P. Shingler, '06, August 19, 1970
Rea E. Blankenbuehler, '09, June 18, 1970
Warren L. Dubois, '09, August 2, 1970
Arthur Lyie, '12, n.d.
Walter Palmer, '13, July, 1967
David F. Gould, '14, July 26, 1970
Edwin D. Hayward, '14, May 30, 1970
William A. Simpson, '14, September 25, 1970
Edward H. Steele, '15, July 29, 1968
Raymond B. Blakney, '16, October 24, 1970
Thomas J. Colbert, '16, September 14, 1970*
Joseph J. Clarkson, '17, September 10, 1970
Charles E. Judge, '17, October 4, 1970
Ernest R. Bridgewater, '18, August 1, 1970*
Leslie A. Jackson, '19, September 26, 1970
Henry Hutchings, Jr., '21, June 26, 1963
Max B. Pearlstein, '21, October 5, 1970
Herbert W. Reinhard, '21, July 15, 1970*
Russell B. Tewksbury, '21, July 6, 1970
George P. Whitten, '22, May 26, 1970
Arthur C. Kirkwood, '24, October 5, 1970*
Lewis L. Bryant, '25, August 15, 1969
Arthur J. Olson, '25, November 15, 1968
Raymond Reuter, '25, June 19, 1970
John H. Stokes, '25, November 9, 1968
Arthur E. Benson, '26, October 14, 1970*
William C. Coker, '26, September 30, 1970*
George E. Faithfull, '26, October 25, 1970*
William H. Graves, Jr., '26, October 9, 1970
Dexter W. Dimock, '28, April 25, 1970
Daniel L. Edlund, '28, July 23, 1970
Marion R. Lory, '28, September 16, 1970*
George H. Reynolds, '28, October 19, 1970*
Robert M. Jones, '30, June 17, 1970
Ross Wood, '30, August 28, 1970*
Harry A. Parris, '31, October 15, 1970
Edward M. J. Pease, '31, September 25, 1970
John W. Hoover, '32, July 3, 1970
John H. Ruggles, '32, July 9, 1970
Mr. John B. Traylor, '32, June 9, 1970
Robert Swain, '33, July 29, 1970
Joseph H. Lancor, Jr., '35, October 18, 1970*
Jack A. Wintman, '36, October 6, 1969
Sydney Cramer, '41, October 14, 1970
George E. Quisenberry, Jr., '44, September 22, 1970
Howard J. Henry, '50, August 13, 1969
Richard F. Armstrong, '51, September 20, 1970
Stephen E. Eisen, '51, June 14, 1970
William Yu, '52, March 28, 1968
George V. Mohn, '55, October 26, 1970
Bertram M. Mullin, '56, June 28, 1968
Roger C. Swanson, '61, May 16, 1970

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Lester C. Thurow in the February issue of Technology Review:

"While it may seem almost axiomatic that more research and development activities should lead to more technical progress, it is difficult to postulate this axiom on the basis of American history since 1940. The question remains: Why not? The answer is unknown."

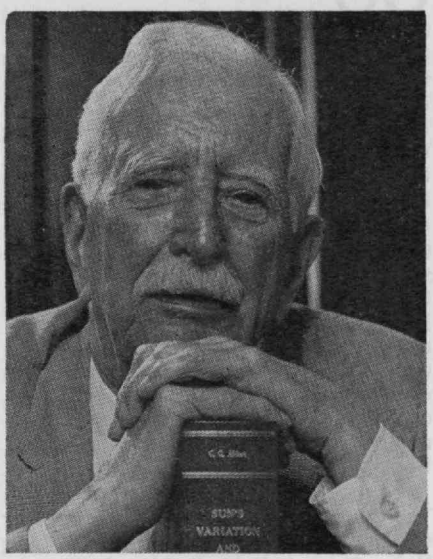
Class Review

94

Ninety-eight-year-old **Charles Greeley Abbot,** astrophysicist, inventor, and author, has yet to retire from a life of research and dedication to science. Recent reports say he has applied for a patent on a method of harnessing the sun's rays as a power source—a method he believes to be economical and practical.

Still connected with the Smithsonian Institution of which he was Secretary and Director of the Astrophysical Observatory until 1944, the Secretary Emeritus now does most of his research at home, visiting the Smithsonian only several times a month.

The accompanying photo shows Dr. Abbot with his book, *Sun's Variation and Weather,* which contains his controversial theories on the link between the sun's



activities and the earth's weather patterns. He has worked out a long-range weather forecasting technique based on the cyclic activities of the sun—the solar body which most intensely captured Dr. Abbot's inquisitive interest. In a recent *Smithsonian* article, Dr. Abbot speaks of his boyhood saying, "At that time I did not care much about the sun, I always hoped it would rain so I could stay inside in our shop rather than having to go out and plant corn."

Few alumni can claim to have arrived at M.I.T. along a stranger route than he, according to this article. "After two years in the Wilton, N. H., high school he had a chance to attend Phillips Academy in Andover, Mass. There in the spring of 1890, a group of his friends were planning to go to Boston to take the entrance examination for M.I.T. Since he had never seen Boston, although it was only 55 miles from home, he decided to go along. When the time came for the other boys to go off to their examination, he suddenly felt nervous about being in 'the great crooked-street city.' So, to pass the time until they were free, he tagged along and took the examination too. He passed it 'without condition' and thus began this long and immensely distinguished career in science."—*Eds.*

95

Celebrated my 97th birthday on October 16, with a luncheon party given by my son. Thanks to the Alumni Association for their birthday greetings.

There was a real surprise in the mail today; I received a certificate of appreciation from *Technology Review* for submitting news of my Class to every issue of the *Review,* Volume 72. Thank you! **Andrew D. Fuller,** Secretary, 1284 Beacon St., Brookline, Mass. 02146

98

We express our sympathy to the family of **Joseph W. Ames** who died on February 11, 1969 at the age of 94. He was in Course II, mechanical engineering but left M.I.T. before graduating. The class had lost contact for a good many years when, in May 1968, Miss Edith M. Ames wrote that her father would be unable to attend the 70th reunion. Her address is 7 Gooch Street, Melrose, Mass.

It is with sadness that I report the passing of **Willard B. Nelson** on August 7, 1969. A graduate of electrical engineering, he led an active life until 1969, enjoying summers at Lake George. His address was with his daughter, Mrs. Joseph F. Collins at 621 De Mott Avenue, Baldwin, N.Y. She wrote "Dad was very well until he fell in February 1969 and dislocated his shoulder. He never really came back from that and by summer was failing rapidly. He just sort of drifted away very quietly, here at home, with his devoted family around him. There are now three great-grandchildren—the oldest is a junior in high school. I so regret that he never saw the youngest, a lovely little girl born in May, 1970. We still have the home at Lake George which he and mother built in 1914, and all of us (three granddaughters and their families) have been coming and going all summer. Dad was a wonderful man who was loved and admired by generations of students at the Manual Training High School in Brooklyn, where he taught for almost 50 years. His devotion to and interest in M.I.T. never flagged—in fact he took me to visit the campus in the spring of 1968."

In August it was my privilege to visit **Lyman Hewins** in Harwich on Cape Cod. Do you remember the news about him last February and his picture taken aboard the Nenemoosha? He still lives on his yacht in Saquatucket Harbor with shipmate Cookie, an extremely talkative bird. Because of general weakness, he is attended by nurses. If you went to the 65th reunion in 1963, you met Mrs. Robert Gallagher, his daughter, who lives in Orleans and visits him every day. His son, Spencer Hewins whom you also met, lives in Maryland and sails him back and forth each year from the marina in Ridge, Md. He is happiest on the water and intends to remain living on it.

The following honors a '98 classmate, the late **William L. Underwood.** Plans for an Underwood-Prescott Professorship in the Department of Nutrition and Food Science at M.I.T. were announced in October 1969. The professorship will be the first endowed chair in the field of food science in the United States.

Remarks in presentation were made by George C. Seybolt, president of the William Underwood Co., and Dr. James R. Killian, Jr., '26, Chairman of the M.I.T. Corporation, at the 1969 Underwood-Prescott Memorial Dinner and Lecture.

In his acceptance remarks, Dr. Killian said that this "first fully-endowed chair in food science in the U.S. dramatizes our urgent need nationally to devote additional resources to this vital field. It is most appropriate that this first chair in food science be founded at M.I.T. The Institute was the first university in the U.S. to establish a separate department of food science and technology; and the William Underwood Co., the nation's oldest canner, played a key role in the evolution of the department through the early collaboration of Mr. Underwood and Dr. Prescott."

The professorship also honors the late Samuel Cate Prescott, the first Dean of Science at M.I.T. The late William L. Underwood was grandson of the founder of the Wm. Underwood Co. Their joint research, which began 75 years ago, revolutionized the food processing industry and was one of the first university-industry partnerships in the country. This partnership combined Mr. Underwood's extensive knowledge of food processing with Dr. Prescott's basic understanding of biological science. Their investigations took place over more than a ten-year period, successfully demonstrating that spoilage of canned foods was caused by bacteria and could be prevented by the use of selected time-temperature relationships in thermal processing. Mr. Underwood later was a lecturer at M.I.T. until his death in 1928.—Mrs. **Audrey Jones Jones,** Acting Secretary, 232 Fountain St., Springfield, Mass. 01108

02

Harold A. Everett, Course XIII, died on October 7, 1970 at his home in State College, Pa. He was Professor of Mechanical Engineering Emeritus at the Pennsylvania State College which he had joined in 1922. Harold started his career after graduation from M.I.T. as an outside machinist with the Fore River S. and E. Building Co., Quincy, Mass. from 1902 to 1903. For the following year he was an estimator and computer for the New York Shipbuilding Co., Camden, N.J. From 1904 to 1915 he served as associate professor of naval architecture at M.I.T. During the next three years, Harold was professor of marine engineering at the U.S. Naval Academy at Annapolis. From 1918-1922 he was the chief engineer and naval architect for the Union Shipbuilding Co., Baltimore, Md.

Harold joined the faculty of State College in 1922 serving as associate professor of mechanical engineering for two years and then as professor of thermodynamics from 1924 to 1931. He became head of the department of mechanical engineering in 1931, retiring as professor emeritus in 1946. The college had conferred the degree of M.E. in 1926.

Among his many summer positions he conducted marine research for M.I.T. from 1910 to 1912 and turbine research for General Electric from 1928 to 1930. Harold was a fellow of the American Society of Mechanical Engineers and a member of both the Society of Naval Architects and Marine Engineers and the Society of Automotive Engineers; he affiliated with many honorary societies.

Harold married Alice de Silva in September 1908 and she survives him as do two daughters, Mrs. Robert M. Johnston, West River, Md., and Mrs. Roland A. Morck, Glen Rock, N.J., and nine grandchildren and nine great-grandchildren.—**Burton G. Philbrick,** Secretary, Greycroft Inn, 68 Dane St., Beverly, Mass. 01915

03

Well dear classmates of soothing climes, both south and distant west, you must be startled at last by your secretary's being confronted with a void for news in our column. The inevitable request for '03 news from the Review office arrives with a due date and (please note), "Due dates are not as flexible as in past years."

I have been successful up to the present time by pleading for classmate's autobiographies, but many of you have not replied. Keep in mind how much more pleasant these biographies are than obituaries.

James S. Sheafe, 450 Blackstone Lane, La Grange, Ill., passed away August 5, 1970; no further information accompanied this notice.—**John J. A. Nolan,** Secretary-Treasurer, 13 Linden Ave., Somerville, Mass. 02143

05

Perhaps because Andy Fisher has not been around to blow his horn we might conclude that **Prince Crowell** had relinquished his command of Cape Cod yacht racing. A reprint of a column in the March 1, 1970 issue of the *Boston Herald Traveler* reminds us that Prince has lost little of his prowess. "In 1934 an active Class Committee was formed in the Southern Mass. Yacht Racing Association and annual regattas instituted. Prince Sears Crowell is an example. His enthusiasm has never waned. He won the championship in 1940, in 1958 and again in 1961, after the modern rigs had been introduced. And Prince is still winning races at the age of 87. This past summer he won the coveted Veeder Cup at the Woods Hole Yacht Club against skippers in their teens. Prince could well have retired at age 79, but this was not his style. He keeps a steady hand on the tiller and a sharp eye for the favoring breeze." Commenting on the above Prince says: "I came out second in my division at the SMYRA this year, and in a borrowed boat." As long as Prince can get into a boat he will probably be racing and winning for many years.

I am proudly announcing that the M.I.T. Alumni Association has awarded me the *Technology Review* "logo" (a silver replica) as a token of, as the citation reads, "our esteem and appreciation for your loyal and longstanding service to M.I.T." I also wish to acknowledge that I have pleasantly received from many of my classmates similar tokens of their appreciation of my services over a period of 35 years. Here's hoping I may continue to serve for a while longer.

In response to the receipt of a birthday card to **Herbert S. Bailey,** he replies, "at age 90, I wonder whether I am the oldest living member of the Class of 1905." Almost, Herb, but **Errett Graham** was 93 on June 8, 1970; **Charlie Mayer** was 90 on October 2, and **Dean Klahr,** 90 on October 26 of this year. Herb adds, "years ago I said I would remain on this speck in the cosmos until I was 96 and if my health continues as good as it is now I'll probably make it." More power to you Herb! He refers to the terrible forest fires which have been raging in his section (Ontario, Calif.) and states that only continuous roof spraying on their mountain cabin saved it.

A. Senior Prince of Cincinnati, Ohio, died on September 4, 1970. No further data is available. My memory tells me that after a few years in engineering he took over his father's wholesale grocery business, which, according to the same somewhat feebler memory is what Carl Danforth and Ralph Hadley did.—**Fred W. Goldthwait,** Secretary-Treasurer, Box 32, Center Sandwich, N.H.; **William G. Ball,** Assistant Secretary, Bradenton, Fla.

06

Back in October we received a note from our Class President, **Stewart C. Coey,** from a retirement home in Newbury, Vt. where he and Betty are now living. With his note Stew enclosed a folder about The Frances Atkinson Residence for the Retired, an attractive, large, building about 65 years old and modernized, with a 40-foot long glassed-in sunporch that has a broad view of the Connecticut River Valley and the White Mountains. The Coeys are enjoying their stay and the service but may move to the Boston area when their daughter gets settled there. Their jointly-owned former home in Wilmington, Vt., is up for sale. They spent the summer months, as usual, on Squirrel Island in Boothbay Harbor, Maine.

There are two deaths to report—**Herbert Callman,** Course VI, on May 9 ,1970, and **Henry Simonds Hubbell,** Course VIII, on August 8, 1970. Herbert Callman was with us only junior year, having previously received a B.S. degree, from what university my available records do not tell. By 1915 he was established as an architect and engineer, the firm being Howard & Callman of Far Rochaway, N.Y. In 1919 his address was New York City, with no address for the next 15 years. In 1935 Herbert was a partner in

the firm of Roman-Callman Co., of Long Island City; in 1955 he was president of Herbert Callman Co. at the same address and he retired around 1960 to Mt. Vernon, N.Y., where he died.

Henry Simonds Hubbell was with us the first two years, fell ill and did not return. By 1915, the first address we have, he was superintendent and acting treasurer of two companies in Ashburnham, Mass., which made tools and such. By or before 1920 Henry joined the United Shoe Machinery Co., Boston, becoming assistant vice president in charge of manufacturing; by 1948 he had retired, first to Dedham, Mass., then to Conway, N.H., his last address. Henry was a loyal classmate, paying his class dues regularly from 1917 to 1955. We have no information about his family or his civic activities. —**Edward B. Rowe,** Secretary-Treasurer, 11 Cushing Rd., Wellesley Hills, Mass. 02181

08

A letter received from Mrs. **William H. Toppan** states that her husband was incapacitated and unable to answer my letter. She reports: "His career has been a varied one and I'm afraid I cannot give you many dates. After leaving M.I.T. he went to the American Sugar Refining Co. in New Jersey. On the day war was declared he volunteered and went to Plattsburg Officers' Training Camp. He was so successful as an instructor, that much to his dismay he was kept in this country for many months. Finally he went to France as a captain in heavy artillery.

"Upon return home he went with the Great Northern Paper Co., in Millenocket Maine. After several years that company sent him to their plant in Madison, Maine to run a paper bag mill. Later he was superintendent and very successfully ran the Cushmore Paper Co. in Augusta, Maine. Then for 18 years he lived in Wilmette, Ill. He was Sales Engineer for a Norwegian company in Chicago, Fibre Making Process, Inc. Because of failing health he returned to Massachusetts in 1951, and lived very happily in Amesbury on the Merrimac River until we came here."

Here is an answer from Miss **Gertrude Marvin Williams** who graduated in life sciences. "After graduating from Wellesley in 1908, my college gave me a two year fellowship in economics. I worked at the Womens' Educational and Industrial Union just across Boylston St. from Tech and I took courses in statistics. Down the years it has been my privilege to take the *Technology Review*. I look at the pictures and read the easier articles. It is the handsomest and best edited of all the college magazines. I congratulate the editors on their handling of recent situations.

"After two years on the old *Boston Transcript* and three years on the *New York Sun* I succumbed to matrimony. We lived in New York City and I wrote seven books, chiefly biographies plus [spending] a year in India, and a book about India and Gandhi. We had no children. After my husband's death in 1941, I taught English in Wilkes College, Wilkes Barre, Pa., and wound up as Dean of Women. Until, at the ripe old age of 73, I called it a day and retired.

"For the last three years I have lived in a Philadelphia retirement home managed by the Friends. They do an excellent job. Finally at 86 I'll admit that after 80 life fades a bit. I recognise the profound truth of the bon mot. Dying is an Art."— **Joseph W. Wattles,** Acting Secretary, 26 Bullard Dr., Weston, Mass. 02193

09

Each fall an Alumni Officers' Conference is held at the Institute, reports of which have appeared in earlier notes. In the fall of 1969 President Johnson established a Commission on M.I.T. Education, of which Professor Kenneth Hoffman was chairman, to re-examine the nature and goals of the Institute. The conference, which is usually held the Friday and Saturday following Labor Day, this year was held Friday, October 17, and Saturday morning, October 18, in order to consider the Commission's report. Our class was represented by **Art Shaw** and your secretary. Some time before the conference the following set of topics, each with a synopsis of their backgrounds, was sent to all alumni officers to be studied and evaluated and later at the conference to be discussed with recommendations submitted.

President Johnson opened the conference Friday morning with an account of the several aspects of recent activities and conditions existing at the Institute. This was followed by brief discussion of the major issues by faculty, alumni and students. We were especially favored by having Warren K. Lewis, '05, Professor Emeritus of Chemistry, renowned chemist and teacher, express his views on past and present technical education. In the afternoon there were panel discussions in smaller groups of the foregoing topics with an alumnus presiding with each group. Many new ideas and suggestions were made by attending alumni. Saturday morning there were programs such as "Research and Teaching at M.I.T."; "Environment Studies at M.I.T."; "The Architecture Machine", etc., with alumni attending the one that most interested them. A concluding luncheon was held in the Walker Memorial at which Vannevar Bush, '16 (Honorary member of '09), was the speaker. He reviewed the present chaotic conditions in the country, agreeing that we have plenty to worry about such as young people soaking up drugs, violence, disruption, appalling crime rate, defeatism and absurdity in our colleges and universities, campus buildings being burned, deans assaulted, and a bomb destroying a college laboratory and killing a researcher. He finds that we have lost our sense of humor (no Will Rogers), courageous spirit, and our perspective. Then he cited the crises which the country has experienced in the past such as the near financial collapse of the thirties, the last World War which we nearly lost to the submarine—all of which we survived. However, he looks for a gradual change for the better due to a greater participation in affairs by the hard core of earnest students intent on an education, and to the fact that M.I.T. will proceed with its task as the outstanding educational institution with the spirit, interest and competence of its body of alumni. (A further description of the conference appears on pp. 92-94 of the Dec. issue.)

At the "Homecoming" last June we requested **Tom Desmond** to state the title of the book on which Alice was then working. He replied in a recent letter stating that he and his wife Alice had returned on September 30 from a visit of nearly three months in England, France, Germany and Italy. One of the purposes of the trip abroad was to obtain photographs as illustrations for another book by Alice (her 20th book) to be titled *Cleopatra's Children* which the New York City publishers, Dodd, Mead & Company, have contracted to publish late in 1971. Another purpose was to inspect European arboretums to obtain ideas that might be helpful in the continuing development of the private arboretum at the Desmond home near Newburgh, New York, which now contains more than eight hundred species of trees and shrubs. Tom made certain surely to return on September 30, so that he could attend the M.I.T. Corporation meetings in Cambridge on October 1 and 2, of which Corporation he, a former President of the M.I.T. Alumni Association, was a Term Member from 1931 to 1936 and then elected to life membership in 1941.

"I hope partly to make up by diligence what I lack in ability," Tom wrote, "for I have not been absent from more than three or four M.I.T. Corporation meetings in the past 29 years." We do admire Alice for her continual writing of interesting, historical books, and Tom, our Vice President, has devoted many years of service to the Alumni Association. As a life member of the Corporation he has contributed much to the progress of M.I.T.

It is with great regret that we report the death of **Samuel** (Sam) **McCain,** 85, on March 30 at Syracuse, N.Y. He was a native of Pittsburgh, Pa., and prepared for the Institute at Allegheny High School. At the Institute he was president of the Pennsylvania Club, member of the Civil Engineering Society (V.P. and Treasurer), and the Class Day Committee. He performed his thesis, "Rating of the Hydraulic Meters of M.I.T." with Lewis Nisbet. Sam spent nearly all his life in Syracuse where he was a widely known realtor and appraiser. He was president of the McCain Realty Co. from 1915 to 1933 and assisted in the establishment of the Pomeroy Organization of which he was an officer until his retirement in

1955. He was a life member of the University Club, a member of the Syracuse Board of Realtors, and a member and vestryman of St. Paul's Episcopal Church. Surviving are two daughters Mrs. Francis C. Burke of Pembroke, Mass. and Mrs. William A. Belden; two sons, Rev. Samuel N. McCain, Jr. of Salem, N.H. and Edwin of Lima, Peru; and eighteen grandchildren.

We have also received a notice of the death of **Joseph H. White** on January 10, 1970, at San Mateo, Calif. Our records show that he was a native of Lawrence, Mass., and that he took Course XI. Apparently much of his work was with mining since early in his career he was in the construction department of the Tennessee Coal and Iron R.R. Co., later with the Bureau of Mines in San Francisco, and then with the Braden Copper Company in Chile. After 1924 he lived in Pittsburgh and Coraopolis, Pa. He married Loretta Dunne in 1916 and there were three children, Alice, Martha, and Joseph Henry.—**Chester L. Dawes,** Secretary, Pierce Hall, Harvard University, Cambridge, Mass. 02138; **George E. Wallis,** Assistant Secretary, Wenham, Mass. 01984

11

I can think of three reasons why an '11er would not come to our 60th reunion. He might be in a financial bind though I surely hope this does not apply to any of us. He might be physically unable to make it. To him, and there are several like him, we send our best wishes and, after it is all over, we will tell him in these notes all that happened. Then there is the one who just isn't interested. Of the 95 to whom the Committee sent letters on October 1, 13 said they expect to be on hand; 6 said maybe and 26 said no. Then there are the 50 who have not returned their cards up to now—five weeks later. I like to think that some of these have not made up their minds and that I'll receive their yes cards later. Those who have attended past reunions know what to expect. Those who have not, missed a lot. If you have misplaced your card a letter to the secretary would be appreciated.

Walter Connolly's contribution to the Alumni Fund was sent in by his wife because he has become nearly blind. I can appreciate what that means as I have recently had cataracts removed from both my eyes and for a while could see very little. I plan to write to him and I know he would greatly appreciate a card from any of you. . . . **Allston Cushing** who graduated from the University of New Brunswick in Fredericton, N.B. in 1909 and spent part of our senior year with us, attended the annual convention of the American War Dads, of which he is National Secretary, in Springfield, Ill. in October. . . . From **Leroy Fitzherbert:** "How beautiful it is to do nothing and after doing nothing to rest." From what I hear, few retired '11ers have found time to rest.

Frank Smith thinks that anyone who intends to go on for a master's or doctor's degree would do well to put in four years as an apprentice at his chosen life work before going to work on his advanced degree. Frank did this so he speaks from personal experience. I have long felt that I would have gotten much more out of my time at Tech if I had worked during vacations. I didn't have to and I didn't. Frank, who is going on 86 years old, has heart trouble and is short of breath, so he is very limited in what he can do.—**Oberlin S. Clark,** Secretary, 50 Leonard Rd., North Weymouth, Mass. 02191

12

DO YOU REMEMBER the bridge sessions at the Tech Union where we first learned to play the game. In those days hearts had the highest count and spades the lowest, unless the bidder called "lilies". Then spades became the highest, the other suits ranking the same as today.

Your secretary attended the second annual meeting of the Class Secretaries at Cambridge on October 15, at which about 40 secretaries were present. Addresses were given by members of the *Technology Review* staff and the problems of the various secretaries in securing and editing class notes were discussed. John Mattill, editor of the *Review* told us that a recent poll indicated that Class Notes was voted by the Alumni to be the most popular feature in this excellent periodical which contains many articles of general interest in new fields of technology and management. Certificates of appreciation were presented to over 30 Class Secretaries in recognition of their contributions to alumni relations and to their Class. Your secretary was included in this group. The following two days were devoted to the Alumni Officers' Conference with over 400 alumni, 50 faculty members and 25 students in attendance. Various problems, such as admissions, curriculum changes in undergraduate education, graduate education, finance, governance, and outside activities, were discussed in detail. The material presented by the three groups will be reviewed by the Institute Commission on Education, who must evaluate and determine future programs and direction—a tremendous task.

George Sprowls was the only other member of our Class to attend the conference. He is in good health and still able to play golf regularly in Akron with a group of retirees. . . . While in Cambridge I talked with **Al Davis** who is well and working every day as manager of the Algonquin Club. He is presently a "bachelor", as his wife, Gertrude, is temporarily confined in a convalescent home following an operation. We wish her a speedy and complete recovery. . . . **Jay Pratt** and Priscilla have both been somewhat under the weather this fall and winter, but report that they are both improving. We all send best wishes. . . . **Jonathan Noyes** returned in September from his summer home in Maine. He drove the long trip to Texas alone. "No news," says Johnnie, "but I was glad to be home and see Caroline and my large family." . . .**Dave Guy** wrote briefly about a visit he made with his wife and daughter to see **Jesse Hakes** and Mary at their home in Maryland. All are well and continue to travel about.

Wallace Murray writes about another adventurous trip he took last summer. "I flew to Bogota, Columbia, an interesting town, where the most modern construction contrasted with the 500-year-old Colonial Spanish buildings and churches. I saw the salt mines and a cathedral built entirely of salt, 500 feet underground. Then we flew to Letieia, where Columbia, Peru and Brazil meet on the Amazon. Here we found an experiment station where monkeys and other animals are raised for research laboratories all over the world. We then flew to Manaus, Brazil, a town that grew rich by raising Para rubber towards the end of the 19th century. About 1910, plantation rubber from Malay and Ceylon broke the monopoly and the city almost died. But now prosperity seems to have returned and its docks are busy with freighter traffic, although the city is 1,000 miles from the mouth of the Amazon. We then flew south to Brasilia and took a small Piper Cherokee into the jungle. These small planes can land on cleared strips and we were soon at an Indian settlement or trading post called Sao Felix, on the Araguala River, a tributary of the Amazon. Here our houseboat was moored and for the next 11 days, this was our home. It was rough, but comfortable, and the country food was excellent. Every day we went on exploring and fishing trips by canoe deep into the jungle, and visited primitive Indian villages. Our stay was so delightful that we hated to leave and go back to civilization in Brasilia. This new city is still unfinished. Its architecture and plan are so modern that they seem freakish and unreal. Much has been accomplished, however, since my last visit in 1963 though completion is not expected until the year 2000. We then left for Rio and spent three days at a hotel on Copacabana beach. Then off to Lima and up to Cuzco, elevation 11,000 feet, which was the old capitol of the Incan Empire. Many of the old Incan walls still remain and the people still tend their flocks of llamas and spin their wool with a distaff. They mostly speak Quechua, the language of the Incas.

"From Cuzco we took a train down into the Urubamba Canyon. As we entered, the scene became wilder, and the narrow walls were almost vertical. We could see the snow capped Andes high above us. We were down 6,500 feet at the Machu Picchu station and could not see the ruined city itself, far up on the top of the cliffs. We went up a switchback road, a rise of 1400 feet, and found a small but comfortable inn. Machu Picchu is a great city built of granite. The thatched roofs have disappeared, but the walls are still in perfect condition. Compared with

Pompeii, Ankor or Chichen Itza, all of which I have visited, Machu Picchu is the most impressive. So much has been written about this city that I need not describe its cultivated terraces, its streets of stairs, its open plazas or its watch towers. At the top ridge there is a magnificent view of the snow-capped Andes. We then flew back to Lima and over the main ridge of the Andes, then north to Quito in Equador where I took a day's trip out into the country near San Domingo to see an Indian reservation. We then flew to Miami and home."

Dr. **Dolph Martin,** Course VII, of Roslindale, Mass., has not written us directly but we have obtained general information regarding his unusual career. After graduation in 1912, he took a graduate course in arts and sciences at Harvard and then obtained his M.D. at medical school. He attended the Ecole Cesar Franck in Paris where he received a Doctor of Music degree. He soon became actively interested in music as a band and orchestra conductor and director of plays at various theatres, both on and off Broadway. He has also been active as a producer of radio and television programs. We are hoping to hear from Dr. Martin soon and to obtain more details of his most unusual and successful career.

Willis Salisbury reports that he spent the summer as usual at his cottage in the woods of northern Minnesota near Grand Marais where he enjoyed the swimming, canoeing, hiking on portages and trails, not to mention the good eating he likes so well along the Gunflint Trail. "Lucky for me that I do not put on weight. Some of my family have been up at intervals; also other friends. And I have many nice neighbors here on Hungry Jack Lake, as well as others nearby. I have always hoped that I'd be favored by visits of members of 1912, but think I must be too far off the beaten path. Do not as yet know what my plans will be for the winter, but hope to get away for three months or so to some warm place,—maybe to Curacao."

Helen and I attended the Parke County (Indiana) Covered Bridge Festival, for the third time, in October. For 10 days, Rockville, the county seat, with a population of 3,000, was host to about 12,000 visitors. Parke County boasts of 36 covered bridges, more than any other county in the country. Large tents were erected on the courthouse square which housed a bazaar and a farmer's market. Here home-made sweaters, linens, sunbonnets and aprons, also persimmons, paw paws, jellies, jams and hornet's nests were sold. Special events included lectures and slides on covered bridges, an excellent local show with a large chorus and orchestra. There was an ox roast, pancake breakfast and huge chicken fry and at special booths, exhibits of the making by hand of pottery, brooms, candles, applebutter, grain grinding by horse power, wooden toys and covered bridges. A unique feature was the scarecrow contest. Residents throughout the county set up all kinds of figures in front of their homes and stores, and prizes were awarded by the votes of the visitors.

On our return trip, we stopped to visit overnight with **Larry Cummings** and Julie in their charming home in the country, 4 miles east of Connersville, into which they moved two years ago. They are both in good health and had recently returned from an auto trip to Minnesota and Ontario. Larry is one of our six class golfers (maybe more), and plays the local course two or three times each week.

We regret to report the passing of **Arthur Lyle** of Penfield, Pa., who took a special course with our Class for only one year. We have not been able to obtain additional information.

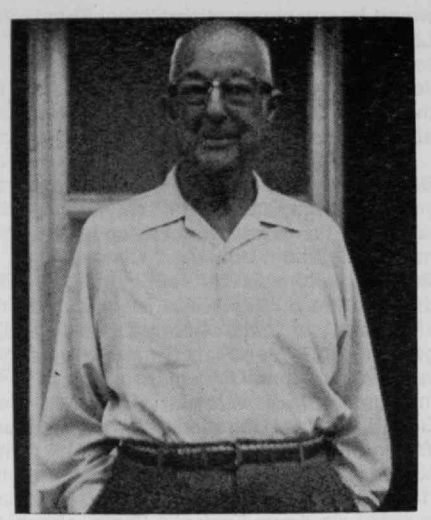
We expect to be in Florida when this issue reaches you. Our mail basket is presently empty, however, so we ask again for contributions.—**Ray E. Wilson,** Secretary, 304 Park Ave., Swarthmore, Pa. 19081; **Jay H. Pratt,** Asst. Secretary, 937 Fair Oaks Ave., Oak Park, Ill. 60302

13

We wish you all a very happy and prosperous New Year-1971. Your secretaries **Phil** and **Rosalind Capen** attended the *Technology Review* seminar for secretaries on October 15, 1970, at the Student Center. John Mattill and Brenda were the leaders. This was a very interesting event, which provided all secretaries the opportunity to express their pet "peeves," and to offer suggestions for better cooperation with Cambridge—particularly with the staff of the *Technology Review.* It was noted that the older secretaries of 1903 and 1912 should be complimented for their accomplishments of rapport with their classmates. Your secretaries regret that due to previous commitments they were not able to participate in most of the well prepared agendas of the committee at the Annual M.I.T. Alumni Officers Conference.

It is interesting to note that your treasurer sent out 150 bills for 1970-71 dues on October 20, 1970, and to date over 60 replies have been received, adding a substantial revenue to our treasury. In answer to our questionnaire: 23 have not voted; 13 report "no"; 9 voted for a reunion on campus; 8 voted for a reunion on the Cape; 2 voted "no opinion"; 2 envelopes were returned "unknown"; 2 were reported by their families as "deceased". As a result of this poll, we should forego a reunion in 1971, but plan on a successful reunion, our 60th, in 1973.

Several comments have been received from our ever thoughtful classmates. **Charles Thompson** reports, "Hope to see you next Monday (26th) at the Council." . . . **Dave Stern** writes: "Hi Phil. Haven't seen you at Boston Rotary for a long time. Fond regards." . . . **Phil Burt** writes: "Hi Phil. Hope you can



Larry Cummings, '12, at his home near Connersville, Ind.

have the Reunion on the Cape. There are many motels in the Hyannis and South Yarmouth areas that cater to reunions and conventions. You're doing a great job on class notes in the *Review.*" . . . **Geoff Rollason** pens: "Hope you and Roz are doing fine. Keep up the good work. Don't know if I can make a reunion in 1971. Hope so. Enjoy your notes in the *Review,* but sorry I have nothing worth reporting. Marguerite sends love to both the Capens." . . . **Allison Butts** adds, "Sorry I could not attend." . . . **Bill Brewster** suggests: "While I would certainly come to either of the above, I doubt if the attendance at either will be large enough to make either worthwhile." . . . **Joe Isenberg** adds, "Greetings and best wishes."

Gardner Alden states, "No preference"; **Stan Parker** adds, "Too far away"; **Herb Shaw** favors the Cape; **Gordon Howie** comments: "You are the one bright spot in this old 'retiree's' life, as you have not raised the cost of belonging to the Class of 1913. You are a master of economics in holding it at $2.00 per year. Everything else even down in Florida, has gone upward. And in addition, you have done a perfect job in carrying on class affairs. While I indicated on the dues notice in regard to interim reunions, that 'I was sorry I could not attend,' this does not mean that I would not favor one. Here are my dues and my best to you."

Charlotte Sage writes: "Rainy day, empty house, very unusual just now, so I'm excavating the desk. Your's near the top, and such a nice small bill. Reunion is out. Personally, I'm still responsible for grandchildren. I'll be curious to see what the majority prefer. Hope you both flourish. Do you feel outraged at Kennedy running? Good luck." . . . **Phil Terry** says, "Greetings." . . . **George Sampson** writes: "Would not be able to attend." . . . **Merril Smith,** "Cannot be there." . . . **Warren Glancey** states: "I think 5-year intervals are enough, especially with a lot of 80 year plus people." . . . **Robert Smith** writes, "I am in my 90th year and

would be unable to attend." . . . **Tom Lough** states, "I believe that I'm getting too lame to attend any further reunions"; **John Ladd** states, "I seldom get up to the New England area, so would not be able to attend."

David Nason narrates: "It is OK for you younger men, but once in five years is oftener than I can perform, and I am not talking about drinking." **Clarence Brett** adds: "I believe I notified you that my wife Ruth passed away last year after about 19 years of happy life together. I am now remarried, and we are very happy, as we have many interests in common. We now live at 3930 North Granite Reef Rd., Scottsdale, Ariz., 85251. We had a nice visit with Jo and **Bill Mattson,** and would be glad to see other '13ers when they get out this way. This summer we drove East and South, about 10,000 miles in all, and saw much of the country that was new to both of us." . . . **Ken Blake** states, "Saving my energy for 1973." . . . **Bill Mattson** adds, "Always glad to hear from you. Hope you are well, also Roz. Another little trip coming up soon. Will spend Thanksgiving with Janet and Frank in California."

Hildy Carlson says, "Enjoy your breezy notes in the *Review.* Trouble with me is that nothing either serious or worthy of note occurs. We hope we can keep it that way." . . . **Bob Tullar** writes, "I enjoy your notes in the *Review.* We are both well and hope the same for you. Kindest regards." . . . **Ed Hurst** adds: "Whatever the majority wish. Glad to see you and your charming wife anytime."

Your secretary has often been confronted with inquiries regarding the present addresses or post graduation activities of our classmates or their relatives. We are happy to announce that on referring to our records, we have been able to supply the desired information. A letter was received from Mrs. **Lee Bowman,** 600 Warren St., Albany, N.Y., 12208, announcing the death of our friend and classmate, Lee Bowman, which occurred on August 23, 1970. Further, Mrs. Bowman wrote: "Lee died suddenly on August 23, 1970. He had been in failing health for some time, with final diagnosis of congestive heart failure. I shall continue to live in Albany where our daughter and family live." She also enclosed a check as a gift to the Class.

Also, we have received a brief announcement that **Walter Palmer,** Route 25, Media, Penn., 19069, died in July 1967. Our secretarial staff has sent notes of sympathy to both of the families of our departed classmates.

Can any of our classmates furnish the addresses of **Frederic Morse,** formerly of Glendale, Calif., and later Minneapolis, Minn.? Also, can anyone supply the present address of **Herbert B. Wood,** formerly of 198 Brandywine Blvd., Wilmington, Del.

We are indebted to the M.I.T. Alumni Fund committee for the following: "Hope you and yours are fine. We have spent the whole year thus far at home in Maryland. Had some hazy plans to drive to New England in August, but a harmless accident, in which only the car and our pocketbooks were hurt, eliminated that idea and put the car in the shop for a month. Hope to drive to Michigan this fall to visit relatives and to show that we can still handle an automobile. **Fred Lane."** It has also been noted that certificates of appreciation will be awarded later this fall to 92 alumni whose efforts on behalf of M.I.T. in the 1970 Alumni Fund were outstanding. They and their co-workers played important roles in making that Fund Year the great success it was. Among the group of Fund workers receiving a certificate is our own class agent, **Ellis W. Brewster.** To you Bill, the members of the Class of 1913 extend our heartiest congratulations for the well deserved recognition of your efforts over these many years.

We have been notified of the 23d Annual M.I.T. Fiesta in Mexico, March 11-13, 1971. This year's Fiesta will be a testimonial to our beloved Chairman of the M.I.T. Corporation, Dr. James R. Killian, Jr., '26, and Mrs. Killian who will be the guests of honor. The program appears very interesting with the various meetings, luncheons, and dinners, together with several side trips to many historical areas in Mexico. The cost of all planned affairs and transportation will be $65.00 per person for the three days in Mexico City. Anyone of the Class of 1913 who may be interested, should communicate with the M.I.T. Club of Mexico at Reforma 116-804, Mexico 6, D. F. (Phone 535-49-20) to secure further details.

We have phoned Dr. **Francis Achard** several times. He has returned home since a cataract operation which was very successful; he is very cheerful. So boys and girls, keep the letters and calls coming. Roz and I enjoy them.—**George Philip Capen,** Secretary and Treasurer, and **Rosalind R. Capen,** Assistant Secretary, 60 Everett St., Canton, Mass. 02021

14

The interesting and important Alumni Officers' Conference in October included not only class officers but those whose function it is to assist the admissions office by interviewing students who have applied for admission to Tech. We have done this for many years, as has **Bob Townend** in New Jersey. He notes: "Dear Herman: You might be interested that Maude and I attended the Alumni Officers' Conference at Cambridge over the last weekend. We took the occasion to make a short trip through southern Vermont, New Hampshire and Massachusetts for a few pictures of the fall colors. The registration at the Conference was 620. Interesting speeches were given by President Johnson, Dr. Killian and Dr. Vannevar Bush. **Les Hamilton** was scheduled to be present though we did not see him. We were told that you had planned to be present also but unfortunately were not able to make it. We did see several M.I.T. men from this area and others we have known. There were a number of discussion groups relating to the problems and opportunities confronting M.I.T. We attended two of these and also had the opportunity of seeing Dr. W. K. Lewis who is now 88 years old and under whom I was an assistant in the Research Laboratory of Applied Chemistry back in 1916. Dr. Lewis' mind is as keen as ever but he admits to slightly impaired hearing and eyesight. With kind regards to you and Mrs. Affel and best wishes, Sincerely, Bob Townend."

Speaking of admissions, we have had two girls to interview this year, the first for some time. I wonder whether this portends an increase in the feminine population at the Institute.

We have the following notice concerning the death of **J. Elliott May** sent to us by his son, J. Elliott May, Jr. "John Elliott May, 79, of 344 Main St., Yalesville, Connecticut, died suddenly July 13, 1969 in the Meriden-Wallingford Hospital. Husband of the late Lillian Prisk May, he was a native of Yalesville and a graduate of Suffield Academy. He earned the B.A. degree from Colby College in 1912 and the B.S. in Civil Engineering from Massachusetts Institute of Technology in 1914. He served in the U.S. Navy during World War I and then worked for a time with the Barrett Co. on the construction of the New York subways. For 30 years he held various positions with Landers, Frary & Clark in New Britain, Conn. and at the time of his retirement in 1955 he was Head of the Cost Analysis Department.

"Mr. May was active in church and civic affairs. He was at successive times the superintendent of the Sunday School, Deacon and Treasurer of the Yalesville Baptist Church. He was one of the founders of the Yalesville Volunteer Fire Department of the Yalesville Water Co. He served for many years on the Board of Education for the Wallingford Public Schools. He was a member of the Compass Lodge A.F.&A.M. He is survived by his son, Dr. John E. May, Jr., two grandchildren Marcia and Gregory, all of Allentown, Pa., and three sisters, Mrs. Otis S. Smith and Mrs. Archibald G. Prisk, both of Yalesville, and Mrs. Wilfred B. Utter of Westerly, R.I."

Alumni Fund correspondence includes a few brief notations from '14ers: "Am now chairman of company I founded in 1930. Have opportunity to travel extensively and will leave October 8, 1970 for South and East Africa, a 6-week camera Safari; and son Walter, Jr., is president of our company, the Hygienic Dental Mfg. Co. **Walter P. Keith."** . . . **Ormonde C. Clisham** writes: "My sole activity is landscape painting, strictly non-profit. Sole income is from Social Security. Need I say more?" . . . **Russell A. Trufant** says he has been laid up with shingles over two years. (We sympathize. We had this ourself some years ago). And **Thorn Dickinson** says, "Come up and see me some time. Our address after October 22,

1970 is: Bradley's, St. Huberts, N.Y. 12943."—**Herman A. Affel,** Secretary, Rome, Maine, P.O. address: RFD 2, Oakland, Maine 04963

15

Happy New Year! With the hope that you and your families have all enjoyed a pleasant holiday season. The Class Supreme—indeed! On October 23, despite one of the worst rain storms and traffic tie-ups in the city here and seven cancellations, 19 classmates and guests showed up at the M.I.T. Faculty Club for our annual Fall Class Dinner. These included such long distance stalwarts as (alphabetically): Wayne Bradley, Moosup, Conn.; Whit Brown and son Crist, Concord, Mass; John Dalton, Providence; Ray Delano, Duxbury; Harry Murphy, Hingham; Charlie Norton, Martha's Vineyard; Fred Waters, Marblehead and Stan Osborn, West Hartford, Conn. No greater interest and loyalty could anyone ask. In addition to these were, Frank Murphy, Azel Mack, Archie Morrison, Wally Pike, the Pirate and Gerry Rooney, Bill Smith and our younger (loyal) members David Hamburg, Jim Hoey and Bill Sheils. Hank Marion phoned from Plainfield, N.J. and Ben Neal from Lockport, N.Y. Cancellations came from Sam Berke, Clive Lacy, Jack Dalton, Larry Bailey, Pop Wood, Max Woythaler; and Gene and Herb Eisenberg. We would have been glad to have seen them all. Better luck next time! Larry Landers couldn't make it but sent a check—many thanks, Larry. What a fine spirit to come to spend a convivial evening with old class friends. Surely a fine group. The lively, enjoyable and enthusiastic meeting opened with the Old Pirate's swashbuckling cheer "We are Happy!" Cocktails and an excellent Bill Morrison dinner put us in a pleasant and nostalgic mood. We're glad you fellows who attended our 55th finally got your pictures. It's not a good picture but the best we could do with an uncertain photographer. After the Class dinner, Charlie Norton stayed over with us—always a welcome guest.

So now we have some colorful and interesting news from and for our widely scattered classmates. At the home-coming event in October at St. John's College, Annapolis, **Phil Alger** was awarded the Alumni Award of Merit for outstanding achievement in his chosen field. From the *Schenectady Gazette:* "The award is presented to alumni for 'Distinguished and meritorious service to the United States or to his native state or to St. John's College, for outstanding achievement in his chosen field.' Alger, adjunct professor of engineering at Rensselaer Polytechnic Institute, received his B.S. in electronical engineering from the Massachusetts Institute of Technology and his M.S. in electrical engineering from Union College following his graduation from St. John's in 1912. He received an honorary M.A. from St. John's in 1916 and in 1968 was honored with the degree of Doctor of Science from the University of Colorado. During his career as a professional engineer, 40 years of which were spent with the General Electric Co., he became a leading authority on electric motors and generators. He holds more than a dozen patents in that field, is the author of several books and more than 100 articles and papers, and has been admitted to membership in more than 30 professional and civic organizations. In 1959, he received the Lamme Award from the American Institute of Electrical Engineers and in 1966 was chosen Engineer of the Year by the New York State Society of Professional Engineers." Congratulations to Phil on this high honor. A new edition of his book, *Induction Motors,* was scheduled to appear last October.

Sam Berke's cancellation letter for the Boston dinner shows he keeps busy: "I regret that it will be impossible for me to attend the Class Dinner in Boston next week. Changing over from running a business to running my personal affairs including a farm is more than I anticipated, but keeping busy without the pressure that I had before makes me very happy. I certainly will try and attend the New York dinner because my affairs are such that I plan to spend one week a month in New York and so it should be easy to work in the New York dinner if we have it." . . . It's good to know **Larry Bailey** has recovered from his recent surgery and other than not being able to cut his lawn, he is doing all right. Keep it up, Larry. . . . **Bill Brackett** "Special stationery and stenography (his own typing) for our Class Secretary-Supreme." Thank you, Bill. He has slowed down in business but still has the Murray Machinery Co. account for paper mill equipment. . . . Good **Jerry Coldwell**: "Our 55th reunion was a great party thanks to you, George, Wally and a few other classmates. I am glad to have the reunion picture with George's identification key. I can look it over and compare it with the ones on our previous reunions. You really did have your problems with that part of the party. Anyway, it was a great celebration and we all know who the guiding hands belong to." Thank you, Jerry!

Late in the summer **Alton Cook** had a delightful trip through the colorful Canadian Rockies. He wrote: "I am sorry to hear of Louie Zepfler's passing but it was not too surprising, for in his last letter he was rather pessimistic and said he was in bad shape. I like the reunion picture and I think George's number and name system is very good. I am definitely retiring this winter and then will have more time for visiting Classmates." We hope we see Alton up here. . . . **Henry Daley**: "I am sorry I couldn't take in the Cape party. However, Frances and I both thoroughly enjoyed the class cocktail party followed by the class dinner at Cambridge. Both you and George and your committee deserve the highest thanks and praise for the success of the 55th reunion. Likewise, you yourself have done a wonderful job over the years in preserving the unity of good old 1915. Our best to Fran and yourself and all our Boston friends, including that young "feller", Jim Hoey, '43, who I helped break in here in Philadelphia in the late 1940's." . . . **John Gallagher**: "My gratitude to our Class Secretary and his assistants for their zealous and continuing efforts to maintain our ties to M.I.T.—strong and functioning and our pride therein always bright and untarnished." Nice words, John, and many thanks.

Think of the good that **Larry Landers** and his wife, Fannie, are doing. The *Newton* (Mass.) *Graphic* of October 15, carried this story with a fine picture of Larry and Fan: "Mr. and Mrs. Bernard L. Landers of Newton were honored recently at Beth Israel Hospital when a new research radiology unit was dedicated in their honor. Attending the ceremonies were close to 100 relatives and friends of the Landers family. Guests toured the new facility and witnessed the unveiling of a plaque which noted that construction of the research unit was 'made possible through the generosity of Fanny A. and Bernard L. Landers.' The new facility—a procedure unit for experimental radiology—will play a vital role in the Hospital's many research programs. Dr. Mitchell T. Rabkin, General Director of Beth Israel, summarized its importance when he told the guests, 'The Landers Research Radiology Unit is designed with one purpose in mind—to bring advances in medicine to the patient's bedside as quickly as possible.' Irving W. Rabb, hospital president, accepted the facility on behalf of the Officers and Trustees. 'This dedication has significance far beyond the physical size of the unit itself, this is rather a symbol of the total love and commitment of two dedicated people, Fanny and Bernard Landers,' Mr. Rabb said. He recalled that Mr. and Mrs. Landers had given consistent support to Beth Israel Hospital over the years and that the new Landers suite, located on the third floor of the Slosberg-Landay Research Center, is but one manifestation of the couple's devotion. Three years ago, a clinical X-ray unit for serving the Emergency Unit and Outpatient Department was dedicated to the Landers in appreciation of their commitment to the Hospital. In response, Mr. Landers expressed the pleasure that he and Mrs. Landers felt in helping to provide the Hospital with a modern experimental radiologic unit. 'My wife and I are proud to be a part of the Beth Israel community and will continue to help it grow and develop.' "

From the Hospital for Special Surgery in New York City, **Ernie Loveland** wrote on September 13, "It was good to hear from you again and I can now report progress. Using the half crutches, I am walking 6 times daily—with a little discomfort but far less pain than at first. I have been pushing myself so as to get my strength back as soon as possible, and have worked up to a total daily distance of over 3 miles. Down in physio-therapy, they told me the other day that the amount of walking I was doing was being commented upon over my entire floor. And for the last couple of days I have

been walking up to 10 short, hesitant steps with the crutches held off the floor. They had told me that it would be at least another month before I would walk without crutches. Perhaps what I am doing could hardly be called walking, but it is a first step towards it, and I guess I am ahead of the schedule. I believe that my recovery rate has been fully up to par. They are now fighting that infection and tell me it is decreasing at a satisfactory rate. I believe that is the only thing that is now holding me here in the hospital, but I am in no hurry to leave. Walking as I do now, using crutches, it would be a little difficult taking care of myself all alone at home in Marion, Mass. I guess that in the last 12 months, thanks to my own toughness plus excellent medical care, I have twice beaten the odds against me. (I hope that the 3rd time is a long way off.) I sure would like to see you and Fran when I get to Marion." It looks from this as though Ernie is going to make it back home to Marion, Mass., and, surely, we wish him all the best. He deserves it.

Ben Neal was awarded a certificate of appreciation by the Alumni Fund Board for his efforts on behalf of M.I.T. in the 1970 Fund. Ben played an important role in making that Fund year the success that it was. Ben had done a monumental job as our Class Agent both for our Class and for M.I.T. and richly deserves his honor and recognition. Congratulations to a swell guy!

Charlie Norton, sage of Martha's Vineyard says that he and Bee (his good wife) are tough old birds and he hopes that if they live too long the Audubon Society will take them over. Ah, me! . . . **Frank Parsons**: "The Reunion picture is all right and it was very thoughtful to have George name and locate each man. This may be our last picture and it's one to cherish." . . . We missed **Larry Quirk** at the reunion and we are glad he has recovered his good health. Not much fun living without some sin, eh, Larry? "I was delighted to receive photo of 1970 Class Reunion at the Cape. A fine looking body of men and Mrs. Rice. The Rooney profile looks like 'Lo—the poor redman.' I was very sorry that I missed the reunion but am looking forward to next April in New York. My son Charles and I made a 4-week tour of the Orient last May—Japan, Hong Kong, etc.—and enjoyed it so much that my latent ulcer kicked up. After a non-stop flight from Singapore to San Francisco, I landed in the Hartford Hospital for one week's rest and relaxation. They put me on a strict diet—no smoke, no drink, no nothing. So, I had to avoid all occasions of sin. However, I feel OK now and am back to work. Thanks, again for the picture and with kindest regards."

In October, **Mary Plummer Rice** returned from a trip of several months to Iceland, England, France, Luxembourg, Yugoslavia, and the islands of Jersey and Guernsey, where she worked with the USO and Red Cross. Hats off to Mary for her energy, vigor and stamina.

Bill Spencer has retired from regular office hours and is on call for consulting work. Enjoy yourself, Bill. . . . **Jim Tobey,** with his son Bill and his wife and young daughter, spent a pleasant evening in Cambridge with Fran and me. Come again, Jim. . . . What a wonderful trip **Bob Welles** must have had. I, too, admire the impressive engineering work in those old cathedrals and in the Rome Coliseum. To those old Course I guys like Wally, The Pirate, these achievements are probably "elementary." "In July I chartered a houseboat on Lake Powell for a week. Lake Powell is a 185-mile-long body of water caused by the building of a huge dam in Glenn Canyon on the Colorado River. The shores of the Lake are almost everywhere immense, perpendicular, red cliffs, broken here and there by deep and narrow side canyons. A bit of zest is added to the cruising there by the difficulty of reaching bottom when you want to anchor for the night. We didn't have much luck fishing, but the swimming was marvelous and most days we went in several times in order to get cool. In August I took my younger daughter, with her husband and 12-year-old daughter, on a trip to France. We flew direct from Los Angeles to Paris in one of the big 747 Boeings, found an Avis rental car ready for us, and drove ourselves about France for nearly a month. Having been born and brought up over there, to me it is still a bit like going home, especially since our old country place is still in the family (belongs to my sister) and we had about a week there, in the Renaissance chateau area. You may remember one of those chateaux, built on the river Cher, and extending all the way across it, named Chenonceaux. Belonged at one time to Diane de Poitiers, lady friend of Henry II, king of France. Our place is about eight miles up river from it. As a boy I spent most of my school vacations there, and loved it. My engineer son-in-law was very admiring of the extraordinary feat performed by the builders of the cathedrals in balancing their heavy vaults with arc-buttresses, way back in the 13th and 14th centuries when a knowledge of mathematics was certainly not common. France has changed a lot, but the food is is still good and we came home loaded with Camembert cheeses. I hope this finds you well. My best regards to you and your good wife."

That sly and cute Pop Wood says: "Thanks for the reunion picture of bald heads and protruding fronts." . . . At the September 1, meeting here of the Alumni Council, **Max Woythaler** was on the Program and Membership Committee. With Clive, Wally and me, Max attends regularly the monthly meetings of the Council at the M.I.T. Faculty Club here.

It's sad to report the death of **Leland V. Clark,** who died August 15, 1970 at Chatham, Mass., and **Donald A. Fowle** on August 6, 1970 at Woburn, Mass. The sympathy of our Class goes to their families.

At the meeting of Class Secretaries during the October Alumni Officers' Conference, I received two awards, one, in recognition of outstanding contributions to our Class and to *Technology Review* as a Class Secretary for 25 years or more. I received a citation and a silver replica of the *Technology Review* logo given as a token of esteem and appreciation for my loyal and longstanding service to M.I.T. The other, in recognition to M.I.T.'s alumni relations and to our Class with representation in every issue of Volume 72. I am profoundly touched by these awards, which I prize and appreciate highly. My thanks to the Review editors. This was an interesting, instructive and illuminating meeting which I thoroughly enjoyed attending. I'm proud that the older Secretaries—say up to 1926—each have their own peculiar and special way of collecting and preparing notes. As one of those "old timers," I am frank to say, it's a hard, tiresome job to meet the relentless and pressured deadline for this monthly column, and, at this writing, I'm just a little weary, so "help Azel." Yours in 1915—**Azel W. Mack,** Secretary, 100 Memorial Dr., Cambridge, Mass. 02142

16

Once more your Assistant Secretary is pinch-hitting for your Secretary. At this writing, Harold is reported to be progressing according to schedule but the schedule covers a considerable period of time. All the letters received in response to our plea for news included well wishes for his early recovery and have therefore been omitted from the individual reports.

One of our General Motors retirees, **Gene Barney** writes from Birmingham, Mich.: "Yours and Harold's appeals have finally touched my heart, so here is a brief comment in answer to your questions. 1) Fast approaching my 14th year of retirement we still have good health and continue to enjoy every moment of it—however, we can't brag about any noteworthy accomplishments. 2) We've travelled, visited relations, played golf and just plain did what we pleased. 3) Last winter, after 3 weeks in Florida, we stopped in Tryon, N.C., to see our good friends the **Allen Pettees.** We are still hoping for a visit from them this fall. 4) The four granddaughters are growing up too rapidly. The oldest is married, is a graduate of the University of Indiana and is now teaching art in the high schools of Bloomington, Ind. The next eldest is in her second year at Ohio State. The next has finished high school and is working for a year to help her decide what she wishes to study in college next year. The youngest is in the second year of junior high. 5) As to philosophy: Life is simple and interesting as long as one has a worthwhile objective and a desire to accomplish it. The multitude of detours and distractions become unimportant and insignificant and overshadowed by the satisfaction of accomplishment."

Our very erudite classmate from Claremont, Calif., **Ray Blakney,** writes on Octo-

ber 20: "This past one and one-half years I have been living mostly in the Greece of the 2nd millenium B.C., or more specifically on the plains by the hill of Hissarlik, in Turkey, where Troy VIIa was, and was destroyed about 1240 B.C., the year Moses died. I'm sure M.I.T.'16, one and all, is well acquainted with what Homer has to tell about the clash of the Achaeans and the Trojans. I had always heard that Homer did a first rate job with that story but I never guessed how first rate it was until I got it going for myself in a verse version. At present I'm crawling along in book XVI and finding it entrancing. I didn't do very well in Greek at the Institute, so the translation goes a bit slowly. But it's a great yarn and fast-moving in English. I recommend it to all.

"Meanwhile last year Laura and I celebrated our golden wedding, and without implying any cause and effect, took a trip up to Newfoundland; rough country with tender people. We stayed in St. Johns with an Irish couple of about our vintage and when we left, we paid the modest bill and kissed both the O'Brians. It was the first time I ever wanted to kiss the landlady. Same conversely for Laura. Incidentally, the last members of a proto-Indian race, the 'Beothuks' were murdered there in 1829 and well preserved remains of two members are to be seen in the museum for those who have at least an amateur interest in anthropology. There is a fascinating story there."

A somber note is introduced by the receipt of a clipping noting the death of **Tom Colbert** of Milton, Mass., on September 14, 1970. The clipping reports: "He was a World War I Army veteran. He began his career as a teacher at the United States Military Academy before becoming an attorney. During the late 1920s he entered law practice and later formed the firm of Colbert and Cotter. He was instrumental in founding the Bay State Raceway after World War II and served as its president from 1960 to 1968. He leaves his wife Lillian M. (Warburton) Colbert; a son, Thomas J. Jr. of Milton, and a daughter, Miss Patricia M., also of Milton."

Kem Dean writes from Houston: "Ada and I have not been doing anything worth mentioning this summer. We did drive up to Sewanee Military Academy in Tennessee for the graduation exercises where one of our grandsons got a diploma. Have a younger grandson still there and his two older brothers are both at the University of Texas. We also have a granddaughter there. Other than that trip to Sewanee, we have taken a few days off several times this summer just for a change of scenery. We like the hill country near Kerrville very much. It is noticeably cooler and the atmosphere clearer than Houston."

It is with great sympathy we report the death of **Barney Gordon**'s wife, Ruth. At this writing we have no details but our hearts go out to Barney in his bereavement and his loss is shared by all who knew her.

We also have a letter from **Paul Harrower** congratulating our Executive Committee on the letter Joe Barker sent to Dr. Bush of The Fisk Committee on the expression of the thoughts of the Class of 1916.

Emory Kemp, one of our Floridians, writes from Sarasota: "Since arriving back from our 54th reunion things have been pretty quiet visiting and seeing the many friends we have made through our church affairs, etc. We also enjoy the wonderful warm sunshine during over 75 per cent of the days." Emory is active in the M.I.T. Alumni Club of South West Florida and is on the executive committee. At a recent meeting they set up a program for the coming year, practically the same as for the past year. "Malcolm, our Class Baby (now 57) is very happy in Santa Monica, Calif., and is still comptroller of the Full Gospel Business Men's Fellowship International. His picture appeared in the October issue of their magazine, *Voice,* with seven other directors at their international convention held at the Hilton Hotel, in Chicago. They had 6,500 registrants at this 17th world convention. As you know Malcolm was always very religious and he is very contented in his work and we both feel very happy for him."

At the October 1916 luncheon in New York **Charlie McCarthy** told of a round-the-world trip he and his Betty are taking beginning early in November. Traveling East to West he plans to be in Australia, Bali and other exotic places in January as these notes reach their readers. They will fly back from London about May 1. Others at the luncheon were Rudy Gruber, Walt Binger, Herb Mendelson and Leonard Stone.

Commenting on the "Small World" item noted in the December notes re Walt Binger's son Bronson, Walt contributed, "I have a somewhat snobbish comment on the "Small World" idea—"It's a Big World but the Upper Crust is thin." . . . **Elsa Habicht Mueser** (Mrs. Emil E.) writes from Mountain Lakes, N.J. She has seen Harold since he returned from the hospital and reports: "He still looks young. We travel to Maine to visit our daughter and her husband who together build boats in Robinhood. An exciting life and daughter Sylvia does more than I did with my excellent education. Reading *Saturday Evening Post Treasury* and *Decline and Fall of the Saturday Evening Post,* I think college disturbances, race rebellions, burglaries and badness of folks in general have always been with us. Still cut grass, rake leaves, grow vegetables, play bridge, hike better than the mini, midi, and granny skirted ladies."

One of our Cape Codders, **Don Webster** writes that he and Nell are living the simple life and didn't cross the Canal Bridge from June to October—although they did spend April in Bermuda. As he is always asked for a bit of philosophy he contributes a quotation from Horace, in Latin, no less (I'll spare you the original): "Seize the day, put no trust in the moment." And he comments, "This may sound like an incautious and short sighted way to live in these mixed up days but Jesus took the same line in Matthew 6:34: 'Take therefore no thought for tomorrow . . .' so I have Pagan and Christian to back me up. In thinking about the current student unrest, I wonder why we, in our learning days at Tech, were so docile and unimaginative as not to find something irrelevant to our well being about which to protest. We even accepted compulsory military training in a day when the country was not warlike and even paid for our soldier suits. Of course we were somewhat subdued by prexy Maclaurin who told us that we were in 'A place for men to work and not for boys to play'."

In mid-October we caught our East Coast traveller, **Will Wylde** as he was about to leave his home in North Adams, Mass., for Bradenton, Fla., for the winter. He writes: "I really haven't anything of interesting news to impart. I have a great granddaughter born about 16 months ago but I suppose that the majority of our classmates are rich in great grandchildren, so that is hardly news. Of course, just being alive and without too many aches and pains is very interesting to me but there again, the majority of our classmates are similarly situated."

Now we have filled our allotted space, so the rest of the correspondence received to date will have to be held over for the February notes. Your secretaries appreciate your response to our pleas for news. If you haven't already, please write us.—**Harold F. Dodge,** Secretary, 96 Briarcliff Rd., Mountain Lakes, N.J. 07046; **Leonard Stone,** Assistant Secretary, 34-16 85th St., Jackson Heights, N.Y.

17

Each year our interim Reunion is better attended. Our first ones at Sturbridge did well, we thought, as in 1963—our 40th—when we had a total attendance of 36. There has been an increase every year to our record of 60 at our 53rd at Northfield this past October. This total was made by 34 men and 26 wives. Here they are, the Ken Bells, Butterworths, Cristals, Dunhams, Dunnings, Erbs, Les Fords, Gilmours, Gokeys, Holtons, Hunters, Ken Lanes, Stan Lanes, Lewises, Loengards, Lunns, three Maeders, Mahers, Neubergs, Rosses, Severances, Solakians, Ray Stevenses, Al Sullivans, Swains, and individuals Ray Brooks, DeBell, Demond, Dodge, Flaherty, Henderson, Hill, Peacock and Seely. We were sorry to learn of **Dud Bell**'s incapacity also **Bill Dennen**'s hip operation. Both couples, regular attendees, were missed and "get well" cards were circulated. Most of us arrived by noon of the first day and were supplied with name tags by Brick Dunham.

The spacious Inn lent itself well to our needs. The Campus Room gave us privacy for all our meals and gatherings. There we had our 5 p.m. "Attitude Adjustment Hour" followed by dinner.

President Lunn extended greetings and conducted a business meeting as there were several who could not be present the second evening. He has kindly submitted the following report. "Treasurer Stan Lane's report on funds showed only a small balance in our class treasury, which should be built up promptly. Most of our members at Northfield made contributions and we need help from the rest of the class.

"Our 1917 Permanent Endowment Fund, initiated by our insurance program, has reached $100,000 and the unrestricted income will go to the Institute as soon as our objective is reached on the Buzz Aldrin Scholarship Fund, sponsored by the Class of 1917.

"As you know we decided at Northfield in 1969 to sponsor a Scholarship Fund for Aeronautics and Astronautics to be known as the 1917 Buzz Aldrin Scholarship Fund, to be presented to M.I.T. at our 55th Reunion in June 1972. We are glad to report that we are 41.5 per cent along the way of reaching our objective. The income from our Permanent Endowment Fund will be credited to the 1917 Aldrin Fund until our objective for it is reached. At another time a vote was taken on our returning to Northfield next year. It passed unanimously; this gathering will be held October 6 and 7, Wednesday and Thursday."

After the meeting we enjoyed another of **Stan Lane**'s travelogs—his films of an extensive Mexican trip. Stan is our official photographer and is accumulating a sizable file. Next year we'll see the 1917 parade of photos he took this year.

Through the efforts of Miles Demond information folders for the various and numerous places of interest in the "Pioneer Valley"—Mohawk area were available. He also made arrangements for us for a Wednesday morning tour of the Northfield Mountain Pumped Storage Hydroelectric project. By the courtesy of the Northeast Utilities companies system a bus took 42 of us on an interesting inspection of this project that will take water from the Connecticut River, pump it one and a half miles inland and up 800 feet through solid rock to a man-made 300-acre storage reservoir atop Northfield Mountain. By using low demand time periods electricity will be used for the pumping, and the peak demand periods will be served by the down flow generation. The tour was interestingly lectured. Besides this project there are plans for extensive recreational developments for this scenic area. There are many interesting things and places to see within short distances from Northfield and several took advantage of this opportunity to see them.

Wednesday afternoon we enjoyed a musical when Susan Lunn and Ken Bell each played piano selections. This was a repeat performance, popular from last year. Frank Butterworth and wife Helen entertained us with a piano duet at the social hour; they were then joined by several for a sing-song. **Les Ford** put together a clever cartoon menu for the Wednesday dinner that illustrated the courses with comment. Copies were supplied for all. (As of November 1, Les is recuperating from a broken leg.)

After dinner an unusual event took place and Ray Stevens makes this special report. "James Charles Flaherty, A.I.A., N.F.S. is still at it. He presented a water color of Kresge to reunion-host-in-absentia Dudley Edwards Bell at the Northfield reunion. The gift was planned before word came that Dud would be unable to attend. We shared the artist's wish to recognize the skill and effort Dud had put into reunion arrangements. And then Jim gave four paintings 18 in. by 18 in., for the benefit of the 1917 Buzz Aldrin Scholarship. One, winner's choice of the four, was auctioned at once, going to Ken Lane who made the highest pledge-bid to the scholarship fund. The remaining three include one of Walker Memorial and two of the entrance to M.I.T.'s Pratt School of Naval Architecture on Massachusetts Avenue next to M.I.T.'s principal entrance. The limestone steps leading to the door are flanked by two great navy anchors. The three pictures are to be auctioned—according to tentative plan as this is written—to the three most generous pledges for gifts to the Buzz Aldrin Fund."

Appreciation has to be expressed to all of you who returned the reunion cards: 36 "yes" cards and 80 "no" for a total of 116. This included 24 cards from widows. As our wives have become more and more an integral part of our Class and our reunions we do hope that a nucleus of our widows will be joining us.

The annual Alumni Officers' Conference was held at Cambridge on October 16th and 17th. A feature of this Conference always is the act "In Grateful Recognition of Distinguished Service to the M.I.T. Alumni Association" whereby Bronze Beavers are awarded. Accordingly a 1970 Bronze Beaver was given to **"Raymond Stevens,** '17, devoted alumnus for over five decades, the wide variety of assignments he has enthusiastically performed for the Institute, Alumni Association, and his Class of 1917 exceed a total of 175 years. As a member of the Corporation, Past President of the Association, Visiting Committee member, fund raiser and advisor, his unselfish service has inspired us and made us grateful. M.I.T. has gained in stature from his contributions to the international extention and application of research to industrial growth." Congratulations, Ray, for it is well earned and deserved. This is the third Beaver award to the Class as one was given to The Class of 1917 three years ago when one was also given to Al Lunn.

For the fourth year the Alumni Fund has recognized the support of the Fund by the Class of 1917 by awarding certificates of appreciation to Class Agents **Ray Brooks** and **Stan Dunning** who, in turn, thank you for your support.

Ralph Ross wasn't content with just running a hospital so now he is building a new one in St. Johnsbury, Vt. . . . **Bill Eddy** is now Chairman of the Board and Chief Executive Officer of Metcalf and Eddy Inc. . . . When **Al Sullivan** moved to Lebanon, N.J., a few years ago it was reported that his clock repair activities would be curtailed. Not So! He's at it busier than ever.

With regret we record two deaths of classmates. **Joseph J. Clarkson** died on September 11, at Hot Springs, Ark. He was the retired chief engineer of Dierks Forrest Inc. . . . **Charles E. Judge** died on October 4, at Attleboro, Mass.

We welcome **Dick Loengard** as Assistant Secretary. He endeavors to keep the New York contingent in line and out to meetings by sending the monthly notices to those of record. These meetings are held at the Chemists' Club, 52 East 41st St., on the first Thursday following the first Monday of each month. All '17ers are urged to remember the day and to come to the meetings which are held in conjunction with 1916. When possible advance notice to Dick is desirable. The meeting on November 5, was attended by '16ers Barker, Evans, Stern and Stone and '17ers Bill Hunter, Clarence Seely and Dick Loengard.—**Stanley C. Dunning,** Secretary, 6 Jason St., Arlington, Mass. 02174; **Richard O. Loengard,** Assistant Secretary, 21 East 87th St., New York, N.Y. 10028

18

Back in 1918 the halls of M.I.T. were unadorned—and in my memory had a certain stark beauty. But, alas, change has taken place. Within the past few years, the main corridors have become the repositories for inscriptions and messages. Now, however, through the joint action of the M.I.T. Commission, the Planning Office, and other groups, the walls have been cleaned and faced with wall board. Murals have been created by students; the most striking one to me is an enormous dollar bill decorating the entrance to the Bursar's office. The purpose of this whole program is to create an environment, a dynamic one, for students on their way to class. Is this progress? I wonder. *(For further comments on this topic see the Class of 1968 column in this issue.)*

Some few weeks ago the **John Purveses, Max Seltzers** and **John Nortons** spent a few hours together in the latter's apartment on a Sunday afternoon. It was stimulating for all of us. We discussed M.I.T. today, particularly the problem of admitting students from disadvantaged minority groups by giving them a time extension to meet admission requirements.

A check of the records revealed that John Norton was the baby of the class, beating me out by only five days. I will now discard my rattle. John, like his brother, Frederick graduated from

Nashua (N.H.) High School and received his degree in physics. He served in the U.S. Marine Corps as an Aviation Cadet in 1918-19. He also was in Massachusetts National Guard and graduated from the Massachusetts Military Academy in 1932. John returned to M.I.T. in 1920 as a research assistant in physics. He became Assistant Professor of Physics in 1926, and an Associate Professor of Metallurgy in 1930. In 1936, John went to Stockholm, Sweden, working on a research fellowship at the American Scandinavian Foundation, and received his degree of Doctor of Science in Metallurgy from M.I.T. in 1932. He was appointed Professor of Metallurgy at M.I.T. in 1936. He has served our Alma Mater in many offices, among them: Head of the Department of Metallurgy, Registration Officer, Chairman of the Faculty, Acting Dean of the Graduate School, and Advisor on Foreign Study at M.I.T. On joining the metallurgy department, John concentrated on the then rapidly developing field of metal physics. His special contributions have been the applications of x-ray techniques to the study of metals and studies of residual stresses in welding and powder metallurgy, particularly in the area of refractory and hard metals. He was awarded the Plansee Medal of the Plansee Society, Reutte, Austria for contributions to the field of powder metallurgy and cemented carbides. This was the first time the medal was awarded to an American scientist. In 1959, he joined with colleagues to form the Advanced Metal Research Corporation. John served on a part-time basis, until leaving M.I.T., and then full-time to the present. He was elected President in 1960. Advanced Metals Research Corporation is located in its own building, in Burlington, Mass.; it employs about 60 people. The firm provides technical consulting services and is engaged in the development and manufacture of instrumentation in the general field of x-ray and electron optics.

John married Rose Eleanor Demmon in 1929 and they reside at 983 Memorial Drive in Cambridge, overlooking the Charles River. They enjoy travel and have a stimulating and interesting milieu. They enjoy outdoor sports including sailing and fly-fishing. About once a week you will see John rowing up the Charles for an hour or more. Keep it up, our hats are off to you—wish we could do as well.

Our most energetic and observant travellers the **Tom Brosnahans**, have done it again . . . this time to the South Pacific. You will be intrigued with their most interesting report which will come to you in a number of installments; the first follows.

"Seventeen of us assemble at the San Francisco Airport for a 23-day tour to Australia, New Zealand and some of the islands in the South Pacific Ocean. After crossing the Equator and the International Date Line, we arrive at the airport in Nandi and quickly pass through the local customs and take a coach to reach the Fijian Hotel at 5:00 o'clock local time. It is a beautiful, quiet setting surrounded by tropical trees and vegetation. We enjoy a much needed sleep for the most of the day. The Fijies comprise about 300 islands, many of which are very small and uninhabited. They were first sighted by Abel Tasman in 1643 and later explored by Captain Cook. In the early days the islands were inhabited by cannibals. There is a legend that one of the more ferocious cannibals ate 1,000 humans during his lifetime. After extensive inter-tribal warfare, the Fijies were ceded to Great Britain by the high native chief in 1874. The islands are now self-governed but retain membership in the British Commonwealth.

"In the evening we drive to Korolevu for the ceremony and dance of the Fire-walkers. Logs and tree stumps are burned in a circle of small rocks about ten feet in diameter. When the rocks become very hot, the burning embers are lassoed and pulled off. Singing and chanting starts while brave youths gingerly walk across the circle. Green leaves are then strewn on the rocks. The Firewalkers joggle and dance on the leaves continuing their song as smoke rises. They claim that a spiritual gift enables them to walk or stand on the hot rocks without injury. Others who have tried it end up in the hospital.

"Another motor trip takes us to Suva on the Island of Vite Levu. We observe sugar cane, bananas, mahogany trees and the Royal Poinciana trees which have a large flat top. There is a profusion of black Myna birds with yellow beaks. They are very tame and come quite close to us begging for food as we eat lunch.

"From the Fijies we fly 2,000 miles to Australia, which was first sighted by Spanish explorers in the sixteenth century. The Dutch arrived in 1680 but made no record of the place of landing or their observations. Captain Cook, an Englishman, landed in Eastern Australia in 1770. He made a detailed record of his voyage and received the credit for discovery. The entire continent was claimed by the British Government. In 1788 Sydney was founded by Captain Phillip.

At that time penal laws in England were very severe. A person could receive a sentence of seven years in prison for stealing a loaf of bread. The capacity of the jails was exceeded. Some convicts had been sent to America, but after the revolution that was no longer possible. They were then transported to Australia to build up the British population there. Sydney is a flourishing city of 2,750,000 people. It has one of the most beautiful harbors in the world, crossed by a bridge which has a main span of 1,650 feet. The top of the arch is 441 feet above sea level. It requires 6,000 tons of paint annually to prevent corrosion.

"On a tour of the city, we note the contrast between the ancient sandstone buildings, designed and constructed by convict labor, and the modern skyscrapers of glass and concrete. A new opera house of unique architecture has a roof which simulates sails as a symbol of the 5,000 yachts at Sydney. It is a controversial building still under construction, at an estimated cost of $75,000,000. The city tour also includes a drive through the suburb of Paddington, where there are many fine homes, art shops and apartments with intricate wrought iron lace balconies, reminiscent of New Orleans."

John Kilduff, Julie Howe and I represented you at the Alumni Officers' Conference at M.I.T. in mid-October (see pages 92-94 of Dec. issue). Congratulations to **Karl Ford** who received a certificate of Appreciation as Regional Chairman for the Alumni Fund in Muncie, Ind.

From Douglas Martin, a more recent alumnus, I gleaned the information that **George Halfacre** has retired from his duties at the New Jersey Zinc Company.

We record with sorrow the death of Louise Fletcher. Thru her constant attendance with Sax at our reunions, we were fortunate enough to get to know her, and the bonds of friendship became strong. Our deepest sympathy goes out to Sax—we shall miss her.

Harold Weber telephoned me the information that **Ernest Bridgewater** passed away on August 1. He has been associated with the duPont Company for a number of years and was responsible for some of their new products. I had considerable correspondence with Ernest just before our 50th. He had made plans to be with us then—but at the last moment an accident kept him in California.

Colonel **Charles W. Lippitt** passed away on June 22, 1970.—**Max Seltzer,** Secretary, 60 Longwood Ave., Brookline, Mass. 02146

19

A letter from **Marshall C. Balfour,** M.D., 111 Morgan Creek Rd., Chapel Hill, N.C. 27514, was welcome. Margaret and Marshall left for Tokyo, Hong Kong, Taiwan and Korea on October 8 for a month's trip during which period Marshall gave a paper in Tokyo at a regional conference on population and family planning. He writes, "Having survived two retirements, I am now a part-time Visiting Professor at the Carolina Population Center of the University of North Carolina."

While in the Washington, D.C. area this summer, your secretary had a good opportunity to visit with **Nelson A. Bond.** Nelson was Pioneer Naval Aviator No. 1345 in 1918 in Boston where he trained at M.I.T. and at Bay Shore. He was flight instructor at Pensacola. Nelson's wife Marion passed away on October 8, 1970 at their home, 2501 Calvert St., N.W., Washington, D.C. 20008. He now works for the Defense Communications Agency and has received two certificates

of achievement from them for his outstanding contributions.

Your secretary had a letter from **Alexis Wiren** in October. He is retired and living in Mallorca but was in the States in October to receive the honorary degree of Doctor of Humane Letters from Dowling College (formerly Adelphi Suffolk College) Oakdale, Long Island, N.Y.

Word was received that **Walter T. Hall** of 315 Main St., Osterville, Mass., passed away on July 29, 1970. He had been associated with E. B. Badger and Badger Manufacturing Co., in the engineering and construction business and had retired to the Cape.

The following contacts and addresses come from the Alumni records: Dugald W. Campbell, 12532 Morningside Ave., Apt. 2, Garden Grove, Calif. 92640; Mrs. Louis Fichter, Apt., B, 6514 Park Heights Ave., Baltimore, Md. 21215; Robert R. Litehiser, 5155 N. High St., Apt. 806-W, Columbus, Ohio 43214; Louis A. Brown, Jr., 1142 Benerwil Dr., Los Angeles, Calif. 90035; Harry A. Zimmerman, Jr., 250 S.E. Park St., Dania, Fla. 32004.

Your secretary will be in Florida until June and would like to see any who come down this way.—**E. R. Smoley,** Secretary, Apt. 11E, 50 East Rd., Delray Beach, Fla. 33444 (Tel: 305-278-4537).

20

All classmates, particularly those who attended the 50th and witnessed the successful efforts of its chairman, **Ed Ryer,** will be pleased and gratified at the news that Ed was awarded the 1970 Bronze Beaver "in grateful recognition of distinguished service to the M.I.T. Alumni Association." The citation reads, "From stage managing the Tech Show in 1920 to general chairman of his 50th reunion, he has spanned a half-century of service to M.I.T. Member of the Corporation, President of the Alumni Association, member and subsequent Chairman of the Alumni Fund Board are but a few of his achievements. His thoughtful insight helped guide the Institute's emergence as a residential university, as a further manifestation of his lifelong concern for the students, alumni, classmates and the general welfare of the Massachusetts Institute of Technology."

Awarded also, at the Alumni Officers' Conference in October, were certificates of appreciation for outstanding efforts on behalf of the Alumni Fund to **Lee Thomas, Perk Bugbee** and **Al Burke.**

George Des Marais represented M.I.T. at the inauguration of Reverend Thomas G. Fahy as President of Seton Hall University. . . . **Morris Lipp**'s visit to Boston at the 50th was noted in the local papers because of his prominence as former city manager of Miami Beach where some of the major landmarks in Miami were developed under his direction. In addition to his B.S. from M.I.T., Morris also holds a Bachelor of Law degree. He is currently a coordinating engineer with Interama, the International Trade Center of Miami.

After attending reunion, Emma and **Ed Burdell** toured New Hampshire, which they love, and then returned to New York to visit their daughter Mary, her husband Edward Keane and their three grandchildren.

Dave Reed is now in Brenard, North Carolina, address Route 3, Box 162 . . . **Henry Lovejoy** is in Milford, N.H., at 26½ High St. . . . After a happy sojourn with his grand family on Cape Cod, **Skeetz Brown** has returned to Scottsdale, Ariz,. where he makes his winter quarters. One of his neighbors there is **Charlie Klingler** of Paradise Valley. . . . A happy and healthful New Year to you all, dear classmates!—**Harold Bugbee,** Secretary, 21 Everell Rd., Winchester, Mass. 01890

21

Happy Golden Anniversary New Year to you and yours! This is the beginning of the year of years in which we all anticipate the joyous gathering of members of the Class of '21 and their wives at our once-in-a-lifetime 50th Reunion celebration, June 3 through 7 on campus in Cambridge. As we go to press, 140 men and 120 wives have indicated probable attendance and reservation cards are still coming in. Have you sent yours to Reunion Chairman **George A. Chutter?**

In retrospect, the more than 500 of us who flocked to the Institute's new Cambridge site in September, 1917, and the more than 100 junior freshmen who joined us in January, 1918, constituted the then largest class in M.I.T. history. Total enrollment was 1,500. Most of the old Boston buildings had been or were being demolished; Army aviators had commandeered Building 1; Naval Aviation was quartered in Walker Memorial, and student activities jammed the dilapidated two-story wooden hut left by Stone and Webster near the old Massachusetts Avenue entrance on a spot now forever memorialized by the Rogers Building dome. In the "back yard" airplane sheds, a machine gun pit, the secretive enclosure where the first armored tank was built and the mobile "Technicolor" laboratory were among the evidences of wartime and peaceful pursuits.

In our senior year, issues of *The Tech* for January, 1921, announced that M.I.T. had grown to 4,000 students and was among the first 20 U.S. collegiate institutions in size. The newspaper's nostalgic reports told of a Musical Clubs' trip and concert, new Corporation XV officers, Institute Committee actions, the christening of the ice in the new Arena on St. Botolph Street by the Hockey Team, the absence of J. Barleycorn at *The Tech's* 40th anniversary dinner and an editorial plea for better student achievement in the coming second term of the school year!

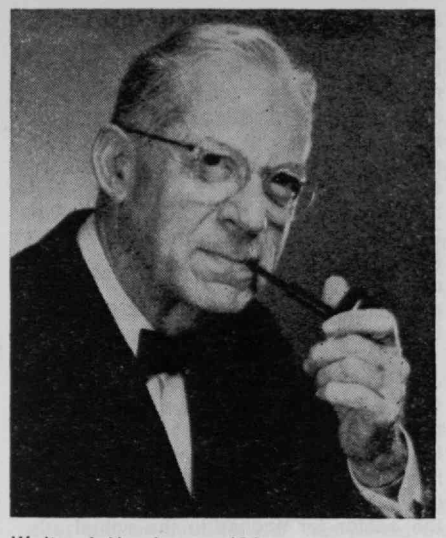
Here's where they are

Revise your recent Class Directory to include these permanent, temporary or restated addresses reported to us this month. . . . Edna and **Philip T. Coffin** have closed their Pittsburgh residence to spend the winter at 1950 Gulf Shore Blvd., Naples, Fla. 33940. . . . **John Dobbie, Jr.,** who long headed the Dobbie Foundry and Machine Co., Niagara Falls, N.Y., has retired to a Canadian home where his mail is delivered to Box 402, Haliburton, Ont. . . . Commander **Glenn H. Easton** has deserted South China, Maine, for a winter home at 1953 Lake Sue Dr., Orlando, Fla. 32803. . . . **Julius Gordon** has reversed the trend and moved from Miami to 106 Dakota Ave., Wilmington, Del. 19803. . . . **Roy Green** tells of moving his home from New Jersey to 16 Idlewild Park Dr., Cornwall On The Hudson, N.Y. 12520. . . . We are delighted to have the new address of Ruby and **Paul L. Hanson,** who have moved all the way from California to be near the large '21 contingent in Florida, as reported last month by **Harry M. Ramsay** of Escondido, Calif. The Hansons now live near Marion and **Philip R. Payson.** Address them at 861 Courtington Lane, No. 21, Fort Myers, Fla. 33901

Another ex-Miami resident is Colonel **Robert A. Hill,** who makes his new home at 1104 Country Club, Blytheville, Ark. 72315. . . . **Walter A. Jayme** notes a local move in New Jersey to 127 Wearimus Rd., Woodcliff Lake, N.J. 07675. . . . **Boris Korvin Kroukovsky,** retired professor of fluid mechanics in charge of the experimental towing tank at Stevens Institute of Technology, Hoboken, N.J., receives his mail via P.O. Box 247, East Randolph, Vt. 05041. . . . **Robert J. Lawthers,** who retired in 1964 from the New England Mutual Life Insurance Co., lives at 102 Avon Hill St., Cambridge, Mass. 02140. . . . Major General **Daniel Noce** reports his address as Sperryville, Va. 22740. . . . **Charles W. Richards,** 2 Lanvale Rd., York Haven, Pa., is President of the M.I.T. Club of Central Pennsylvania, headquartered in Harrisburg. . . . **John W. Shepard** has moved from North Easton, Mass., to 2408 Maya Palm Dr., Boca Raton, Fla. 33432

Receive special recognition

A Certificate of Appreciation has been awarded in recognition of paramount effort on behalf of the 1970 Amity Fund to **Samuel E. Lunden,** principal in the architectural firm of Lunden and Johnson, 453 S. Spring St., Los Angeles, Calif. 90013, who has retired from two years of service on the Amity Fund Board. Sam is a member of the prestigious M.I.T. Development Committee and the recipient of the Bronze Beaver from the Alumni Association. His many activities for M.I.T. and its alumni include that of director and past president of the M.I.T. Club of Southern California, Honorary Secretary of M.I.T. in Los Angeles and member of the Los Angeles Area Council of the



Walter J. Hamburger, '21

Amity Fund. Sam has established the Samuel E. Lunden Leadership Grant at the Institute, a scholarship fund providing an annual stipend to a freshman who evidences the potential of becoming a leader in the affairs of the nation.

Walter J. Hamburger, 15 Crest Dr., Dover, Mass. 02030, has been awarded honorary membership in The Fiber Society, the fourth such honor conferred since 1948. A former president of the society and a founder and former chairman and chief executive officer of Fabric Research Laboratories, Inc., Dedham, Mass., Walter continues in semi-retirement as its vice chairman. Accompanying the presentation by Dr. Milton M. Platt, M.I.T. '42, president of the society, was a citation stating the award was "in recognition of Dr. Hamburger's many basic contributions to the field of fiber mechanics, his pioneering work in the engineering of textile structures, its application to the solution of important industrial and military problems and the inspiration he has provided to his colleagues throughout the world."

Walter has received numerous honors including the Olney Medal of the American Association of Textile Chemists and Colorists, the Harold De Witt Smith Memorial Medal of the American Society for Testing and Materials (A.S.T.M.), his selection to deliver the first Edward R. Schwarz (M.I.T. '21) Memorial Lecture of the American Society of Mechanical Engineers, and the delivery of the Edgar Marburg Lecture of the A.S.T.M. Walter holds B.S. and M.S. degrees from M.I.T. and a doctorate from Polytechnic Institute of Brooklyn. He has lectured at many universities and holds membership and past officership in a dozen professional societies and scientific organizations in the U.S., Canada and the United Kingdom. He has been awarded a number of patents and has authored a long list of technical articles. Janet and Walter have a married son, a married daughter and six grandchildren.

Joseph Wenick, 37 Cedars Rd., Caldwell, N.J. 07006, retired chief engineer of Lightolier, Inc., was an invited speaker on "Business Controls as they Relate to Manufacturing" in a two-day seminar devoted to "How to Start and Operate a Small Business," held in the M.I.T. Alumni Center of New York early last year. The program was designed both for young alumni and others interested in starting their own business or about to enter general management. Joe is assistant treasurer of the M.I.T. Club of Northern New Jersey and a life member of its board of governors.

Your Secretary was among a group receiving citations and tie-tacks representing the logotype of *Technology Review* for having served as class secretaries for 25 years or more and for having prepared Class News for every issue of the volume that ended last summer. Awards were made at the Class Secretaries' Workshop in October also attended by Assistant Secretary **Sumner Hayward.**

Alumni Officers Confer

For two days following the Class Secretaries' meeting, officers of alumni activities were guests of M.I.T. at a series of discussions of the five major issues under consideration by the M.I.T. Commission. The *Review* has covered the meetings as well as the opening general session addressed by our distinguished classmate, President **Howard W. Johnson;** the Alumni Awards luncheon; the keynote address by Corporation Chairman Jim Killian, '26, and the special program on new departures at the Institute. Among those of our Class taking part in the various sessions were George A. Chutter, Maxine and Carole A. Clarke, Edouard N. Dubé, Sumner Hayward, Gertrude and Henri Pell Junod, Leon A. Lloyd, Robert A. Miller, Arnold C. Rood, Edwin T. Steffian and Joseph Wenick.

Of special interest at the conference was our opportunity to chat with the father of Emerson D. Callahan, '48, the Reverend Baldwin W. Callahan of Newtonville, Mass. He had attended theological schools with two of the four ministers in the Class of '21—the Reverend **William Fairbank Hastings,** Fredonia, N.Y., and the late Reverend **Samuel H. Miller,** dean of the Harvard Divinity School—and also knew the Reverend **Williston Wirt,** Claremont, Calif. The Reverend Mr. Callahan once preached in Gardner, Mass., and knows Rod Bent, '19, whom we hope will continue his past practice and attend our 50th.

Reunion Chairman reports

A regular monthly meeting of the Reunion Committee was held in conjunction with the Alumni Officers' Conference. George A. Chutter, Reunion Chairman, led discussions with Cac Clarke, Ed Dubé, Sumner Hayward, Al Lloyd and Royal Wood on a variety of interesting topics supplementing the tentative program for events starting June 3, 1971, and extending through Homecoming on June 7. George supplied a picture of the group of '21 men who gathered for a cookout at his home in East Dennis last September.

From left to right: front row, P. A. Nelles, Jr., P. B. Crocker; second row, G. A. Chutter, R. W. Haskel; back row, R. A. Miller, S. E. Lunden, H. F. Stose, F. M. Rowell—all of the Class of '21, at a cookout at the Chutters' home on Cape Cod.

He expressed regrets that **Donald B. McGuire** and **Austin N. Kirkpatrick** had been unable to be there and remarked that their presence would have meant 100 percent attendance of the '21 men on the lower Cape. Present with their wives were, besides Marion and George, Percy Crocker, Bob Haskel, Sam Lunden, Bob Miller, Phil Nelles, Fred Rowell, and Harold Stose.

George reported numerous additions to the list of probable Reunion attenders you received with his October letter—totaling 140 men and 120 wives at last November 1 as noted above. If you haven't already answered, send your card to George at the address given at the end of these notes or write him if specific information is required. Letters with further details of our most important reunion are going out from time to time, but only to the list of those who have signified probable attendance.

Marion and George and Maxine and your Secretary discovered that they were taking autumn tours through the midwest over the same general routes but in reverse directions. We went to visit Anne and **Wallace T. Adams,** 2606 Fleming Rd., Middletown, Ohio 45042, and had a delightful stay of several days. Art museums, Wally's Boy Scout camp, the beautiful Church of the Ascension of which he is senior warden, tours of Indian mounds and ancient settlements were crammed into gorgeous fall days. We had a most enjoyable visit with Ruth and **Arthur R. Harvey,** 101 Kensington St., Middletown, and were glad to learn of Ruth's improved health and determination for both to attend our 50th. It was also a treat to talk with **Ollie Bardes** by phone in nearby Cincinnati and we were sorry our schedule did not permit a trip to see him. From Middletown, we drove to Grand Rapids, Mich., for the fifth anniversary of our daughter and son-in-law, Eleanor and Joe Blanton, and to see our granddaughter. Discovered a new M.I.T. Club of Grand Rapids but no scheduled meeting. We caught up with the Chutters, who were visiting their son, Roger, his wife and daughter in Grand Rapids. While we stayed on, the Chutters drove to Cincinnati to visit another son, Raymond, and his family.

Mail messages
From his home, Freeman Lane, P.O. Box 126, East Brewster, Mass. 02640, **Donald B. McGuire** writes a much-appreciated letter which says, in part: "Complying with your suggestion in Class News, here are some notes for inclusion in the *Review* prior to our 50th Reunion. I smiled a bit when I read in the July/August news that I was 'present' at an M.I.T. luncheon in Orleans. It just so happened that in a moment of weakness I had accepted the chairmanship for Cape Cod for the 1970 Amity Fund drive and had invited my six vice chairmen and their wives to attend a 'kickoff' luncheon to meet each other and hear the Fund Director tell of M.I.T. as it is today. The presence of Marion and George Chutter and Helen and Bob Miller added a welcome official tone to the gathering.

"Following my retirement in 1963 as chief engineer of Orange and Rockland Utilities, Inc., Middletown, N.Y., Millie and I have enjoyed life on Cape Cod. There is never a dull moment and we have our share of visitors. Retirees in the area relish weekly meetings, except July and August, of the 'Orleans Coffee Club,' a discussion group which settles the problems of the world. Our motto: 'Often in error; never in doubt.' Also there are monthly dinner meetings of the Universal Club, a Masonic social group, and the Brewster Mens' Club. I have been active in the Brewster Taxpayers' Association, the Brewster Old Mill Committee and in my church. I have a complete woodworking shop and enjoy making reproductions of antique furniture in cherry and black walnut.

"We have taken long auto trips, including our annual jaunt to Florida. Our first 11,000-mile trip to the West Coast afforded better appreciation of the immensity and beauty of our country. Our second crossing of 9,000 miles was via the Trans Canada Highway, a magnificent road that touches all the provincial capitals. We are fortunate that our children live near us. Our son, Don, Jr., and his wife, both Middlebury graduates, live in Huntington, L.I., N.Y., with their four children. Our daughter, Janice, a Wheelock graduate, and her husband, Paul Rothery, Jr., M.I.T. '51, live with their two children in Suffield, Conn. I must express my sincere appreciation for the wonderful contribution you have made to our Class in your work as our Class Secretary for these many years since graduation. Thanks so much, Cac."

A brief note from **Saul M. Silverstein,** board chairman of Rogers Corp., Rogers, Conn. 06263, tells of starting on November 1, his foreign trip No. 29 to Greece, Israel, India, Japan, Honolulu and Rogers installations in Chandler and Phoenix. He was scheduled to return near the end of December. Along with handsome mounted sets and booklets of philatelic treasures from all the stops on trip No. 28, Saul explained his cryptic reference to the English edition of *PHP Magazine.* The October 12, 1970, issue of *Time Magazine* reveals the title stands for "Peace and Happiness through Prosperity." The new English edition is Industrialist Konosuke Matsushita's extension of the 1.5 million circulation of a new type of publication. Saul was honored with an invitation to write a short article, "C'est la Vie," which philosophizes on lengthening the optimization time of one's experience and enthusiasm in management. Saul bounds his observations with zero experience and 100 percent enthusiasm of the individual at the start and exactly the reverse at retirement.

A group of letters from Ed Delany, Al Genaske, Dug Jackson, Irv Jakobson, Bob Miller and Rufe Shaw—which we'll publish later—all say they saw the Passion Play in Oberammergau during their 1970 European trips but no coincidental meetings were reported there! And from our dear M.I.T. friends in Mexico comes an announcement of the 23rd annual Fiesta of the M.I.T. Club of Mexico City on March 11-13 as a testimonial to Jim and Mrs. Killian. All '21 men interested in attending this year should write the club at Reforma 116-804, Mexico 6, D.F., for registration forms.

In Memoriam
With heavy heart we report the passing of two of our number and extend to their dear ones the sincere sympathy of the entire Class.

Herbert William Reinhard, 257 Cabot St., Newtonville, Mass. 02160, died on July 15, 1970. Born in Boston on July 25, 1899, Herb prepared at Dorchester High School and joined us in the freshman year. At M.I.T., he was a member of Phi Kappa, Masque, manager and president of the M.I.T. Orchestra, manager of Tech Show Orchestra, Catholic Club, Corporation XV and the Institute Committee. He was a corporal, Infantry, in the S.A.T.C. at M.I.T. during World War I and captain, Chemical Corps, in World War II. He received the B.S. degree in Course XV. He was the owner of Protective Coating Co., Newtonville, corrosion engineers and manufacturers of special coatings. His memberships included the National Association of Corrosion Engineers, Knights of Columbus, Catholic Alumni Sodality, St. Vincent de Paul Society and the Retreads. He was a past commodore of the Hull Yacht Club. Surviving are his wife, the former Miriam Fitzgerald of Boston; the Reverend William T. A. Reinhard, O.M.I., Oblate College, B.A. and M.A., Catholic University, Sacred Theology, and Ph.D., Gregorian College, Rome, Italy, and Richard W. Reinhard, Jr., Boston College.

Laighton Evans, 1098 Locksley Court, Woodbury, N.J. 08096, died on July 22, 1970. A native of Easton, Mass., he was born on October 3, 1898, and attended Easton High School. Joining us in the freshman year, he was active in the Chemical Society and was a private in the S.A.T.C. at M.I.T. during World War I. He received the S.B. and S.M. degrees in Courses X and X-A and served as an instructor in the Chemical Engineering Department at M.I.T. for a year before joining Bethlehem Steel Co. He retired in 1965 as supervising coke oven engineer for five plants. He was a member of the American Steel Institute and the Eastern States Blast Furnace and Coke Oven Association. Survivors include his wife, the former Martha E. Drake of Pittsfield, Maine; a married son, Richard L. Evans, Lehigh; a married daughter, Jean D. Osterheld, and seven grandsons. We are indebted to George Chutter for data on both classmates.

Join '21 in 'Seventy-one
Only a little more than five months remains for you to complete travel plans to be in Cambridge with your wife early in June. We will be the guests of M.I.T. in McCormick Hall, which will serve as the center for access to the actual events on the reunion program. Please dig up the personal data sheet attached to the Class Directory and return it right away to give your secretaries much needed news. We'll send another copy on request if you can't locate it. Our sincere thanks go to you if you have already extended us the courtesy of sending it in.—**Carole A. Clarke,** Secretary, 608 Union Lane, Brielle, N.J. 08730; **Edwin T. Steffian,** Assistant Secretary, Steffian, Steffian and Bradley, Inc., 19 Temple Place, Boston, Mass. 02111; **Sumner Hayward,** Assistant Secretary, 224 Richards Road, Ridgewood, N.J. 07450; **George A. Chutter,** 50th Reunion Chairman, Box 305, Boulder Drive, East Dennis, Mass. 02641

23

Our Class Secretary-Treasurer, **Tommy Rounds** has become swamped temporarily with consultant activities and has asked me to give him a lift in regard to our class notes for a month or two. So, please don't hold Tom responsible for anything that appears in this column. Knowing full well that I do not have his finesse in preparing class notes, I undertake this assignment with some trepidation.

Reports have reached me that there are many in the class who have not yet filled out the forms sent by **Dave Davenport** in connection with the Class History. If you happen to be one of these, please overcome your modesty or your lethargy and advise Dave that you are still alive and that you are returning to him the information concerning yourself in line with the request indicated on his form.

We have received the following news items from some of our classmates: **Joseph H. Cox** reports that he has been keeping very busy and doing some traveling. He and his wife drove recently to South Carolina from California to visit their daughter. . . . **Dave Joy** spent some time fishing in Canada in August. He also toured Ireland, England, and Scotland in September. Dave found the trip very interesting and reported that the weather cooperated well. . . . **Bob Hen-**

derson states that he has done considerable traveling and has been active in a number of local activities such as Red Cross, Old Guard, SAGE (Summit Area Gerontological Effort), and church. We think that such activity on Bob's part is enriching the life of his community and we commend him for it.

F. La Verne Smith has retired from Signal Oil and Gas Company and is now doing part-time consulting. . . . **Herman Swett** reports that he is leading a quiet life. He and his wife (Evelyn) play golf twice a week and go swimming every day. It is probable that such enjoyable and beneficial activity is keeping this couple in excellent physical condition, which we certainly hope is the case. . . . **Harry Green** has resigned from Engelhard Minerals and Chemicals Corporation and, after a three month's loaf, has joined the Intsel Corporation, 825 Third Ave., N.Y., N.Y., 10022, which engages in the International trading of metals.

Norman Leo Weiss has become Editor-in-Chief of the *Minerals Processing Handbook* to be published by the Society of Mining Engineers of A.I.M.E. early in 1974. His usual Consulting Work has been interrupted thereby, but he hopes before too long to be able to resume a regular schedule. . . . **W. G. Blake** and wife put themselves and their car on the Canadian National from Montreal to Vancouver and took the boat up the Inside Passage to Skagway and vicinity. They just missed having a train wreck on the White Pass and Yukon Narrowgage R.R. The Blakes returned to Vancouver and came home by way of New Mexico.

Bert Warren spent a very pleasant three months last spring as a visiting professor at the American University at Cairo. Although there was a war at the time, he was very well received and treated.

Professor **Nathaniel H. Frank** is obtaining the necessary academic regalia to participate in the dedication of Wentworth College of Technology on November 14, 1970. . . . **Phil Coleman** has received a certificate of appreciation for his efforts in connection with the 1970 Alumni Fund Drive, which was eminently successful.—**James A. Pennypacker,** Assistant Secretary-Treasurer, Long Hill Road, Essex, Conn. 06426

24

So here we are entering 1971. Only five more years to go before Halley's Comet comes around again. Walt Gress wonders who will run out of gas first, Halley's or the Class of '24. Well, that comet has been making its rounds for a long, long time, probably millions of years, and you can't argue with success. Some time ago **Everett V. Martin** turned up an interesting story about its reputed effects—let Ev tell it. "My wife and I were on a trip through Central and South America. In Costa Rica we hired a taxi driver guide who took us on various tours of the city and countryside.

"One of these trips took us to Catargo, the ancient capital, where the local garden club had planted beautiful flowers inside the ruins of an old church. It had been destroyed by an earthquake in 1910, but most of its walls were still standing. Our guide then explained in detail that the whole town had been destroyed by the same earthquake and that it 'had been caused by the earth passing through the tail of Halley's comet.'

"I saw that comet and well remember the excitement and forebodings stirred up by the newspaper reports about what was going to happen when the earth passed through its tail. So far as I remember nothing did, so you can imagine my surprise when our guide told us the above in all good faith."

Dolph Santos's $3,000 worth of vacation came to an end on August 3 when they arrived back in Sao Paulo. In the interim he and Hanne had covered a lot of ground, visiting friends in England, Germany, Austria, and Portugal. They experienced widely varying weather as well as terrain. At Obertauern in the Austrian Alps they had beautiful weather and saw green meadows, alpine flowers, and babbling brooks. Then they went away for a few days and when they returned—a foot and a half of snow. And that was in mid-July!

We can now give you the answer to another query we raised a few months ago: did **Ernie Kallander** get his handmade golf course finished on target in 1970? The answer is "Yes." It is a 9-hole, par 3 course, and it was opened to the public on a daily fee basis last June. "We have done only a little better than break even so far, but we are confident of doing much better next year." That's the Stony Brook Golf Course, and Kal neglects to give an address, but since he lives in Southboro, Mass., it's a fair assumption that's where you will find it. Drop by sometime and set a new course record.

The Cardinal tribe is still contributing to the population explosion. **Paul Cardinal** and Lorene now have a total of 25 grandchildren, and they became *great* grandparents in June. They have been busy touring around visiting family. The latest trip was 3,900 miles, which really isn't a very high mile-per-grandchild average.

Chris Conway is not confining his retirement activities to travel, golf, and bridge. His latest venture was to purchase a Baldwin electric organ to give vent to the music in his soul. Then, having begun the process of electrification, he invested in an electric golf cart, "to save the drudgery of hauling a heavy golf bag around the course in this hot (Louisiana) climate. Adds greatly to enjoyment of the game." And still another facet of his activites: "Won 'Garden of the Month' award from combined Alexandria-Pineville garden clubs. How about that?" How, indeed. Obviously Chris is not one to let the grass grow under his feet—or in his garden.

There must be something about the Louisiana climate that channels people's interests in like directions. **Sam Helfman** has lived there for years. He has now retired from the post of executive vice president of Barnard and Burke, Inc., Baton Rouge consulting engineers, although he is still retained as a consultant. Consultant to consultants? Now consider his retirement interests: travel, golf, bridge, and gardening, exactly the same lineup as Chris Conway's, except for that electric organ. Maybe that will come.

John McN. Hunter, a Course VI graduate, has spent his entire career in the academic field. "Started teaching physics at Prairie View College in Texas, then transferred to Virginia State in Petersburg, Va. Have remained in Virginia for 45 years. Married Miss Ella Louise Stoke in 1929. Took a Ph.D. in physics from Cornell. Retired from Virginia State in 1966, but upon request stayed on another year. Retired as Dean, Director of Graduate Division, and Professor of Physics." A very distinguished career.

Some more address changes, all but the first seeming obvious. **Walter J. Gress** writes: "Here we go again. My new address is P.O. Box 92, Bridgewater, Conn." This could be retirement, but Bridgewater is in an area with a lot of water, and Walt has retired so many times only to go back to work on another reservoir project, that he is immediately suspect. In any event, we shall not announce another retirement. The seemingly obvious ones are: **Joseph T. (Red) Lusignan** to Delray Beach, Fla., **Joe W. Young** to Fullerton, Calif., and **Francis MacMillan** to Palm Springs, Calif.

Among the workers "whose efforts on behalf of M.I.T. in the 1970 Alumni Fund were outstanding," the name of **Frank R. Shaw** stands out like a beacon light. Frank received a Certificate of Appreciation.

Before his death **Avery A. Ashdown** was told that he had been awarded a Bronze Beaver, the Alumni Association's highest honor. It was only one of many honors Ave had received in a lifetime of devotion to others, but he must have been pleased.

The accompanying citation reads:
"For 50 years (Avery A. Ashdown)
has been part of M.I.T. as student, devoted teacher, alumnus and alumni officer. As a committee member, first faculty resident on campus, Master of the Graduate House since its inception in 1933, and member of the Alumni Advisory Council for 31 years, he has constantly sought the betterment of the Institute by encouraging students to become active alumni. His personal attention to generations of M.I.T. graduate students in their daily work and in his introductions of them to fellow alumni, have successfully involved thousands of students and alumni in M.I.T. affairs, caused the naming of Ashdown House in his honor, and have made him the personification of loyalty and interest in M.I.T. in the eyes of his many friends."

Arthur C. Kirkwood received a master's in electrical engineering with us after he had graduated from Stanford. In 1947 he founded his own consulting engineering firm in Kansas City and had been its Senior Partner until recent months. He had been active in a great many professional, civic, and church activities. After a long illness he died on October 5. Arthur's son Beverley, a junior partner in his business, is a 1949 graduate of Course II. To all the family, our sincere condolences.

And so we start another year of news, some good, some bad. Let's hope, on balance, the good outweighs the bad by a considerable amount.—**Henry B. Kane,** Secretary, Box 177, Lincoln Center, Mass.

25

In October your Secretary had an opportunity to attend his first Alumni Officers' Conference. He found it most instructive in providing a general review of Institute affairs and of particular value as a special meeting for Class Secretaries. At the latter **F. Leroy Foster** (Doc) received two awards: the first and most important for outstanding contributions to his Class and the *Technology Review* as Secretary in appreciation for loyal and outstanding service to M.I.T.; the second in appreciation for representation in every issue of Volume 72 of the *Review*. The last is also dependant on how well fellow alumni provide bits of information; hope that cooperation continues. Members of our Class in attendance arranged to sit together at one of the dinner meetings and it was fun to talk with a few that we do not see so often: **Joseph P. McCarthy,** Rumson, N.J.; **Karl Van Tassel,** Chicago, Ill.; and **William R. Wheeler,** Southbury, Conn.

Roger Ward reports that after a five-month freighter trip he is satisfied that the world is round. He also comments that he was impressed with Malaysia and would like to return and stay for a while; nice country and people, with possibilities for industrial development. . . . After retirement **Finlay G. Cameron** worked two years for a consulting firm as general manager of the Saigon Power Co. He has now re-retired and is living in Coronado, Calif. . . . **William F. Arnold** retired from the Sprague Electric Co., and is now enjoying country life in Charlestown, R.I. . . . **Frank P. Van Deren** is retired and his chief interest seems to be a barbershop singing group. . . . **Ed Kussmaul** appears to be retiring in stages. The Kelek Company, of which he was part-owner, has now become the Kelek Division of Arrow-Hart, Inc.; Ed has been named Chairman of the Division. He assures me that he is finding more time to devote to leisure.

A certificate of appreciation will be awarded to **James R. Geddes** for his outstanding effort in behalf of the 1970 Alumni Fund.

A telethon was conducted on October 7. While the primary objective was an appeal for contributions a secondary was the opportunity to talk with classmates with whom we do not have too much direct contact. For this reason those who participated—Doc Foster, Jim Howard, Ed Kussmaul, Harold Robichau, Sam Spicer, Frank Turnbull, Courtenay Worthington, and Wallie Westland felt that the evening was well spent.

I have received information that **F. Graham Cunningham** came over from Freedom, N.H., and was at the reunion on Friday afternoon. His name was not included in the published list of those in attendance.

A note from **Henry N. Sachs** indicates that he is making a twenty-day trip to Budapest, Vienna, Paris, and London under the auspices of the Confrérie des Chevaliers du Tastevin of which he is the Archiviste (Secretary). The group will be the guests of the Hungarian government for six days and will attend the 20th anniversary celebration of the Confrérie in Paris. . . . A clipping from the publication of the Massachusetts Society of Professional Engineers states that **Lynn Wetherill** is chairman of a board established in connection with a new registration law for engineers and land surveyors.

I regret to report the following deaths: **Lewis L. Bryant,** Kembridge, Va., August 15, 1969; **Trafton B. Mason,** Tampa, Fla., February 24, 1970; and **Raymond Reuter,** Bradenton, Fla., June 19, 1970.—**E. Willard Gardiner,** Secretary, 53 Foster St., Cambridge, Mass. 02138

26

All mornings at Pigeon Cove do not sparkle—this one is quite drab. The sea has been wild for days and the undertow provides a constant dull roar and it's raining. I didn't pick the day to write class notes, it just happens to be the last Sunday morning before the deadline. With such an introduction it certainly is not fitting to pick up a sheaf of newspaper clippings telling about the passing of several classmates. That is the case however, so we may as well face it. The first one was sent to us by Jim Killian and was taken from the *New York Times,* October 26: "**Edward Faithfull,** a New York patent lawyer long active in civic affairs here, died yesterday in Northern Westchester Hospital after a long illness. His age was 66. Born in London, Mr. Faithfull prepared at the Phillips Academy, Andover, Mass., and the Ecole des Roches in France for the Massachusetts Institute of Technology where he received a B.S. in 1926. After graduating from Fordham Law School, he was admitted to the New York bar in 1931. He was with the patent law firm of Pennie, Marvin, Davis & Edwards, which later became Davis, Hoxie, Faithfull & Hapgood, in which he was a partner at his death. He is survived by his widow, the former Lucia Frances Turner; three daughters, Mrs. Sidney Faithfull Van Zandt, Mrs. Gail Faithfull Keller and Lucia Faithfull; and three grandchildren."

Another clipping came from Mrs. Esther Benson telling of the recent passing of her husband and our classmate "Art." **Arthur E. Benson,** 67, of 711 North Birch Road, Fort Lauderdale, Fla., a former official of U.S. Rubber Co., died Wednesday in Broward General Hospital, Ft. Lauderdale. Mr. Benson had retired in 1965 as technical director for Uniroyal Export, with headquarters in Geneva, Switzerland. He started his 40-year career in the tire and rubber industry as a tire development engineer with Fisk Rubber Co. of Chicopee. He had made his home in Fort Lauderdale only for the past year, formerly living in Detroit, Mich.

"A 1926 graduate of Massachusetts Institute of Technology, Mr. Benson was a member of the M.I.T. Alumni Association, American Society of Mechanical Engineers, and Belcher Lodge of Masons, Chicopee. He leaves his widow, Mrs. Esther (Carlson) Benson; a son, Richard E. of Ferndale, Mich.; and a granddaughter."

The third (and why do they run in threes?) comes from an attorney in Franklin, Va., and this time it is **Bill Coker.** To quote once again: "William Caleb Coker, 69, retired civil and construction engineer and until recently engineering consultant to Union Camp Corporation, died this morning after a long illness. Coker had been a resident of Franklin for 33 years. He was born in Marion, S.C. He graduated from M.I.T. with the degree of Bachelor of Science.

"He was a member of the American Society of Civil Engineers and of the Kappa Alpha Fraternity. After his post-graduate work at M.I.T. he was employed by South Carolina banks in engineering and appraisals, then by J. E. Sirrine & Co., of Greenville, S.C., from which he went in 1937 to Union Camp Corporation, then Camp Manufacturing Company, Inc. at Franklin. He was a member of the Franklin Baptist Church, a former chairman of the Franklin School Board, and member of the Franklin Rotary Club. His wife, Louise Williams Coker, died in 1964. He is survived by two sons."

Now that we have taken care of the unpleasantness, let's look at a few cards and back-of-the-envelope notes. A card from **Tony Gabrenas** postmarked Roma says: "Dear George: This year I toured Europe, Lithuania, Russia, Sweden, France, Switzerland and Italy. Retirement is not so bad, providing one keeps active. Will see you on 45th reunion." Glad to see you are planning to be with us next June—a reunion just wouldn't be without Tony. . . . A note, and I must say a hard to read note, from **John Fletcher** corrects me for creating the impression that Naples, Fla., is now his permanent residence. While he retired from the Tariff Commission a year ago and does spend considerable time in Naples, John wishes us to know that his

A familiar sight at Pigeon Cove, Mass.—George Warren Smith, Secretary of the Class of 1926, readies his boat at the yacht club. (Photo by Webb, courtesy of *The Rockport Eagle.*)

mailing address is still 4400 East West Highway, Apt. 204, Bethesda, Md. 20014.

A back of the envelope note from **John Sanborn** says: "Retired in November, 1969. Plans for the future have been upset by the passing away last June of my wife, Alice." . . . And one more note from Colonel **Arthur Fuller** gives indication on the reunion and a fleeting report on long lost **Phil Richardson**: "In connection with the San Diego M.I.T. Club's last telethon, discovered Professor Philip Richardson, '26, had been living in San Diego for years. I didn't get to see him as he was catching a plane to his new home in Maine. As far as I know, he was the only classmate here. Hope to see him at the upcoming 45th reunion, and all other classmates."

Sorry we could not, on this dull day at Pigeon Cove, get cranked up with some of the anecdotes we like to send along. However, **Don Cunningham** has called a meeting at the reunion committee for Wednesday night. So next month we should be able to start feeding you something about plans for our 45th. Until then—Cheerio!—**George Warren Smith,** Secretary, P.O. Box 506, Pigeon Cove, Mass. 01966

27

Wanted: A 1927 M.I.T. class ring. Don Severance, '38, Executive Vice President of the Alumni Association, has had a request from Professor **Robert S. Woodbury** of M.I.T., who started in our class, later attended Swarthmore, and actually graduated in the class of 1928. But the 1927 ring is the one he wants. L. G. Balfour no longer has the die, but how about looking in that jewelry box in the top drawer of your chest?

Pub Whittier has again taken advantage of his leisure retirement time to write us: "Ruth and I had the pleasure of spending a few days with Molly and **Jim Lyles,** plus a grand dividend when **Dike Arnold** dropped in. To say that tongues wagged is the understatement of the day! Jim continues to be an inspiration to us all and Molly too, bless her. . . . Since I too am enjoying the 'harvest years' your copious notes lead me to dusting off my 1927 *Technique* and renewing old acquaintances. If you don't object, I would like to set the record straight in one case: **Jack Wiebe** was probably one of the outstanding athletes in our Class. The aforementioned *Technique* states: 'Jack Wiebe, a versatile and consistent point winner, obtained two firsts in the broad jump, and also made points in the 100-yard dash and the javelin throw.' The foregoing occurred during the 1926 season. So much for ancient history, but Jack was quite a guy, God rest his soul. . . . I am 'keeping busy' as a packaging consultant. Ruth and I went to Europe where I handled some work for Owens-Illinois International Division. In addition, I am consulting for the Glass Container Manufacturers Institute on the development of a highspeed packaging facility for the beer and soft drink industries. Since Dick Cheney is managing director of G.C.M.I., perhaps this could be called some form of nepotism!" Thanks for this letter, Pub, and I'm specially glad that you added to what had previously been said about Jack Wiebe. I'd certainly like to hear from others "enjoying the harvest years."

On a recent trip by car, I phoned **Bob Hancock** in Jackson, Mich., but found he was vacationing in Pinehurst. In St. Louis, I called **Frank Mesker** but there was no answer. Sorry to miss them both.

I hadn't heard from **George Standley** in a long time, but he reports that he retired from IRC Fibers Division of Midland Ross Corp., in 1969; he had been assistant manager of rayon research. Now he is consulting in the textile and rubber industries. His wife died five years ago; a married daughter lives in Oregon and is finishing her Ph.D. thesis for Boston University. I assume George still lives in Rocky River, Ohio.

Al (Alden) **Reed** has represented the Nashua Corporation of Nashua, N.H., on the Pacific Coast for the past 30 years. Now he is retired and enjoying it; he writes: "At times we yearn for New England, but our roots are deep in California where we have two sons, each of whom has provided us with a granddaughter." Al lives in Palo Alto, Calif. . . . A note from **George Brady** tells of his continued work as president of the Federation of Citizens Associations of the District of Columbia, plus some space technology consulting. His home is in Washington and he has a summer home in Leland, Mich. . . . Glad to hear from **Sam Levine**, who is still practising patent law in Washington, D.C. . . . **Jim Flagg** has retired after 35 years with T.V.A. His home continues to be in Knoxville, Tenn.

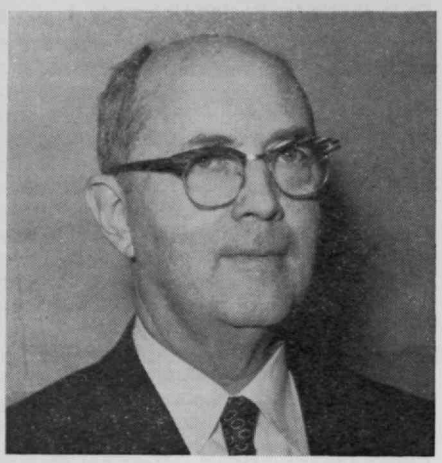
Emory Patterson, whose permanent residence is in Brunswick, Maine, has a summer home in Weld, Maine. He retired from Stran-Steel Division of National Steel in 1965. . . . Professor **Lloyd Bingham,** who retired from the University of Colorado two years ago, has his basic home in Boulder, Colo., summers in South Hero, Vt .. . . **Dave Truax,** whose home was in Charlotte, N.C., has a new address in Lake Worth, Fla., but this could be just for the winter. . . . **Lenvik Ylvisaker,** likewise, is in Boca Raton, Fla., at least for the winter. . . . **Edward Wells** has a new address in Hilton Head Island, S.C.

All class secretaries who have been on the job continuously for the past 25 years or more have been awarded a silver replica of the *Technology Review* logotype (the emblem which appears in the upper lefthand corner of each cover). Your secretary is the proud possessor of one of about a dozen presented at the recent Class Officers' Conference.

Twenty-five years ago, the '27 Notes said that Ed Cahill was drilling wells for Skelly Oil in the snowy Rocky Mountains. "However," he wrote, "anyone who braved those icy Boston winds on the Charles River Bridge for four years, shouldn't let a minor disturbance like a Colorado blizzard bother him."—**Joseph S. Harris,** Secretary, Box 654, Masons Island, Mystic, Conn. 06355

28

At the Alumni Officers' Conference in October, 1970, our esteemed Class President, **Jim Donovan,** became a recipient of the 1970 Bronze Beaver, highest and most prestigious award of the M.I.T. Alumni Association. The citation reads: "In grateful recognition of distinguished service to the M.I.T. Alumni Association, the 1970 Bronze Beaver is awarded to James Donovan '28. For over 45 years, first as a student and then as an alumnus, he has assumed numerous leadership



J. Donovan, '28

roles in virtually every area of alumni activities and, while serving as an alumni officer, has maintained an active concern and association with M.I.T. students throughout his postgraduate years. Above all, his work and dedication have been instrumental in developing the extraordinary interest and loyalty to M.I.T. by his Class of 1928 with its unique success and high degree of service to the Massachusetts Institute of Technology." Jim, we are all both proud and immensely pleased that your loyal efforts on behalf of the Institute and Class have been so appropriately acknowledged. We congratulate you most heartily!

We have received a good number of brief but nonetheless welcome news items: **Bennie Hough** says: "Unlike some of my classmates, I am continuing in active practice as a consulting engineer in the field of soils and foundation engineering. I have been working in this field for more than 40 years and I feel it would be a shame to quit now as I am just beginning to learn the business." . . . **Roland Hutchings** writes: "Retired from Department of the Navy as naval architect (stability), January 1969. Also stopped teaching calculus (evenings) for University of Virginia. My hobby is oil painting which I began after retiring and enjoy very much. Subjects include landscape views from our 8th floor windows and still life arrangements. My general health is good but my wife's is frail and this precludes travel." . . . From **Max Parshall:** "Mary and I are thoroughly enjoying retirement. We have had a large number of guests this summer but no one from M.I.T. We had a card from **Fred Lewis." . . . Max Bearon** reports that he was in the hospital a year ago with two ruptured discs followed by a blood clot. This brought him close to eternity. He recovered in good shape and spent some time late last summer in Europe and in Israel. . . . **Art Elliott** represented the Institute at the Installation of Dr. Ernest Sirluck as President of the University of Manitoba on November 5, 1970.

We have had two picture postcards. One was from **Dave Haynes** at York Beach, Maine, showing Dave's lobster boat as a distant speck in the harbor. Dave wrote: "According to the '28 Notes all retirees work too hard. Not me, I just go lobstering every day. They are free to anyone who calls." . . . The other card, from Clara and **Bill Archibald** was postmarked in Nara, Japan, October 1, 1970, and carried the message: "We are visiting around and doing some sightseeing. I may get to visit a steel plant but, being retired, my interest is partly academic. We hope to see the Ikeharas before leaving the country." We might mention here that Bill has been recognized recently for his outstanding Alumni Fund work and has been elected a member of the Alumni Fund Board.

An announcement in *ASM News* tells us that **Thomas G. Harvey,** Materials Engineer, U.S. Navy Avionics Facility, Indianapolis, Ind., was one of 200 members of the American Society for Metals selected to be A.S.M. Fellows. These are outstanding individuals who have distinguished themselves in some phase of metallurgy, materials science or engineering, research, design, development, production or management.

Tom Larson sent in the following newsy letter: "Lillian and I took a trip in April and May of this year to England and Scotland. We went primarily to visit our daughter Linda, her husband Dr. D. M. Behrendt and their three children. They had been in London for a year while Doug was getting special training in infant heart surgery. Now they are back in their home in Winchester, Mass. Doug is back at Massachusetts General Hospital as Senior Resident and will be Chief Resident, Thoracic Surgery, as of January 1, 1971.

"We travelled with Marge and Dave Truax (Class of '27) and had a delightful trip by bus from London to Lincoln, Harrogate, Edinburgh, Keswich, Chester, Stratford-on-Avon and back to London. We stayed mostly in old English country hotels which were delightful. While in Edinburgh, Dave and I made the trip to St. Andrews and played the Old Course on a cold and windy day in April. It was quite an experience. The televised British Open in June was accordingly of particular interest since we knew the course.

"Our son Bob lives near us in Morris Plains, N.J., with his wife Pat and their two children. Bob got his M.S. from the Sloan School of Industrial Management at M.I.T. in 1959 after graduating from Wesleyan in 1957. He is Manager of the Operations Research Division of Esso Math and Systems, Inc., with headquarters in Florham Park, N.J. He travels the world for Esso and goes to M.I.T. occasionally on recruiting assignments. I am still working but only part time and for the same company, American Hoechst Corp. This I expect to do for another year, then Cape Cod beckons. Lillian and I expect to go to Lake Worth, Fla., this winter then back to Summit for the spring and summer with the Baltusrol Golf Courses only 3 miles away. I was very sorry to hear of Bill Gorfinkle's passing in August. We were in many of the same chemistry classes for four years. He was in the same high school class with Lillian."

It is always a special pleasure to hear from one of the girls of the Class. **Roberta Lovely Halligan** sent in this note: "I am still following the same old routine as Health Officer (Caldwell Borough, N.J.) with stamp collecting and bowling as diversions. A broken wrist last May changed the routine a bit but I am practically fully recovered from this except for the usual manifestations of broken bones when one gets past the '30' mark. At present, retirement, like a Ford, is still in the future but I am beginning to give it some serious thought. Greetings to all '28ers!" Roberta included a most interesting newspaper writeup on her career. Discussion of the item justifies more space than we might be allowed at this writing and we may do better by presenting it in the next issue.

With deep regret, we have two classmate deaths to report. **Marion R. Lory** died on September 16, 1970 after a long illness and hospitalization. Marion had been retired for about a year from Westinghouse Electric Corp., East Pittsburgh, Pa., where he was Engineering Manager, Large Rotating Apparatus Division. He also had various civic, Masonic, and professional interests. He leaves his wife Carolyn, two sons, Charles B. and Donald W., and four grandchildren. Son Charles (Class of '55) received both his S.B. and S.M. degrees at the Institute.

George H. Reynolds died on October 19, 1970, after a short illness. He was in the hospital at the time. Bud had retired from Goodyear Atomic Corp. only a few weeks earlier. He joined Goodyear directly from school in 1928 and held various administrative positions during a long and illustrious career. He was general manager of his company during the past ten years. He was prominent also in professional society activities and held various civic posts of responsibility. Besides his wife Ellen, Bud left two sons, Robert of York, Pa., and Richard of Kismet, Turkey, a daughter, Barbara Cameron of Panama City, Fla. and eight grandchildren.—**Walter J. Smith,** Secretary, 209 Waverly St., Arlington, Mass. 02174

29

I was pleased to receive a letter of appreciation from the Editor of *Technology Review* for having contributed class news to nine consecutive issues of Volume 72. Those of you who sent me letters and notes made it possible for me to fulfill my obligation as your class secretary, and those who thought about sending news items and never got around to it may do so now to reach a similar goal for Volume 73.

Fred O. Urban, Course VI, of Idaho Falls,

Idaho, is an engineering consultant for Idaho Nuclear Corp. For 40 years he has been in various phases of the engineering profession. Most of the time was spent with General Electric Company until that company's work with the National Reactor Testing Station was taken over by the Idaho Nuclear Corp., in 1969. Fred began his career pioneering many air conditioning designs and methods which are still in use. In 1959, he began work in irradiation of fissile and non fissile materials for the materials testing reactor at N.R.S.T., and is currently active in the design and application of codes to the study of the kinetics of sudden pressure releases in enclosed Napor systems. Fred has been honored with the highest A.S.H.R.A.E. honors and is a life member of I.E.E.E.

John Russell Clark, of Course XVI, of Dallas, Texas, was recently elected a Fellow of the American Institute of Aeronautics and Astronautics during its 7th Annual Meeting and Technical Display at the Astrohall, October 19-22. The citation commends "his contributions to the development of naval aircraft and, more recently, the development of the V/STOL concepts." John is presently senior vice president, LTV Aerospace Corp. . . . A Committee on the Presidency, appointed by the M.I.T. Corporation, included **Paul V. Keyser, Jr.,** current president of the Alumni Association.

Harold M. Weddle, Course XV-I, of Riverside, Ill., has retired from Dewey and Almy Chemical Co. after 40 years of service—the last 23, as plant manager of the Chicago plant. He has two sons, both practicing attorneys, one residing in New York and the other in Montana. He writes, "The last several years my wife Esther and I have traveled extensively: 1965, Europe; 1966, Middle East; 1967, the Orient; 1968, Iberian Peninsula and Morocco; and 1969, South America."

Donald L. Hibbard, Course IX-C, of Moylan, Pa., is presently the executive vice president, Board of Pensions, Presbyterian Church, Philadelphia, Pa. He was born in the Philippines of missionary parents. Receiving his A.B. in a small college in Kansas, and B.S. and Ph.D. in math from M.I.T., upon graduation, he worked for Aetna Life Insurance Co., in Hartford and later for Equitable Life Insurance Co., of New York, until he was called to the Presidency of Parsons College in Iowa. During the war, he was in the navy stationed at M.I.T. and became a captain in research and development of O.N.R. He made many contributions in training devices in aeronautics. After the war, he was asked by the Presbyterian Church to straighten out its pension and insurance program. He writes, "We struggle with the management of about 250 million in assets, but the real problems and joys are in the personal relationships. Things 'spiritual' continue to interest me and I find them of growing importance." He concludes by saying, "Kay was president of the Dames when we were at M.I.T. and she has been a perfect companion and helpmate all these years. Somehow, we managed to keep a daughter reasonably straight—until she married a minister and now he has his hands full."

Malcolm M. Hubbard, Course VI, of Newton, Mass., has been appointed chairman of Boston Aero Leadership Gifts for the Class of 1929. Let us give him all the help we can. . . . **John J. Wilson,** Course XV, of Brookline, Mass., Secretary of the M.I.T. Corporation, has been appointed a member of the Alumni Board. . . . **Gordon Carr,** Course IV, of New York, writes, "My son, Andy, who graduated from Cornell in architecture, has entered M.I.T. for graduate work in architecture. I keep busy with the same program and had the honor of a featured write-up about the work of my firm, in the national *A.I.A. Journal* in the May, 1970, issue."

A brief note comes from **Theodore S. Alexieff,** Course I, of London, England: "Are there any twenty-niners, Course I or otherwise, in this part of the world? Swapping experiences could be fun." . . . **Harry C. Weare,** Course I, of Stratford, Conn., writes: "Wife Elenor passed away last January. Her sister, Marjorie, wife of **Harold C. Pease** also passed away last May. I have left my employment with C. W. Blakes Co., of New Haven, to pursue my own whims. I am in semi-retirement." . . . **Hunter Rouse,** Course I, of Iowa City, Iowa, sent me a note which reads as follows: "Dear Karnig: I had fully intended to send you a card from Crete, where Dori and I spent the last week of July at a conference on Engineering and the Future of Man, but the time slipped by. Last week, however, I attended the Water Resources Symposium at M.I.T. celebrating completion of the new third and fourth floors of the Hydrodynamics Laboratory, and thought of you. Gordon Williams was there too. A fine paper was given by Thomas A. Marlow, a civil engineer of the Class of '55, the son of **Arthur B. Marlow,** whom the directory (but not *Technique*) lists as a member of our class. At a reception given by the President for the Corporation, I had the pleasure of seeing Paul V. Keyser, Jr., in action. It is good to see the '29 column in the *Review* so regularly. Keep it up."—**Karnig S. Dinjian,** Secretary, 32 Oldham Rd., Arlington, Mass. 02174

30

As promised in last month's Notes, I have reviewed the Class Profile sheets that Joe Harrington prepared and analyzed at the 40th reunion. From Joe's summary it appears that of the 47 classmates who filled out these forms 43 have been married once and 4 have been married twice. They have an average of 2.9 children, specifically, 1.5 boys and 1.4 girls. Nine of the children are or were M.I.T. students. The respondents drive 2.1 cars, have retained 54 per cent of their hair and the remaining hair is 38 per cent white. Seventy per cent said that their principal field of activity since graduation was what they had studied at M.I.T. There were 13 retirees. Off-beat hobbies included locksmithing, wine-making, raising Santa Gertrudis cattle and collecting Greek and Russian icons. One wife speaks 6 languages and runs a school for orienting foreign diplomats. Another wife is a golf champion and judges dressage. There was, of course, a good deal more information on the forms that cannot readily be summarized.

One of the by-products of the reunion was a newsy letter from **Win Hartford,** who attended with his wife Mary. He started his letter by asking me to pass on his thanks to the reunion committee and ended it with a request to "let Mary and me just rave once more over the fabulous fortieth at Wianno." Win retired from Allied Chemical on November 1, 1969 after 36 years of service and continued to do some consulting work while looking for a teaching job in a climate less rigorous than upstate New York. As of mid-August he became an Associate Professor of general and physical chemistry at Belmont Abbey College in Belmont, N.C. (new address below). During the interval between retirement and teaching he wrote a couple of book chapters—one for Snell-Ettre's *Encyclopedia of Industrial Chemical Analysis* and the others for a new book on wood preservation. Win's principal hobby is hiking and mountain climbing, with choral singing a close second. In connection with the latter activity he has worked on a dozen or so major productions, being on stage in nine of them. The Hartfords have two children: Doug, who is doing public relations work for Southern Colorado State in Pueblo and Janet who is doing graduate work in geology at Case-Western Reserve in Cleveland and is also married to a geologist. Last summer they did field work together in California.

Other retirees include: **Jim Saunders,** who retired on August 31, 1970 as principal of Northbridge (Mass.) Junior-Senior High School after serving 38 years in the Northbridge school system; **Dick Whitehead,** who retired on March 31, 1969 as Santa Barbara County Planning Director after 23 years in that position, but has remained active as a planning consultant; and **George Holt,** who retired after 27 years on the art faculty at Bennington College and is now raising trees "to benefit even a minute portion of the environment on Space Ship Earth."

We received a note from **Ted Bridge,** who attended the reunion with his wife Eleanor; after commenting on the fact that "it was great fun to see classmates in June after forty years," Ted says that he continues to find computer programming a very challenging occupation and enjoys life more than he ever did. However, he is starting to do a little graphics on the cathode ray tube and is "somewhat overwhelmed." . . . **Bob Henderson,** who worked for Climax

Molybdenum Co. for many years before his death in May 1965, has had a mine named after him. Climax plans eventually to invest some $200,000,000 in the Henderson project, which by 1975 is expected to produce some 50,000,000 pounds of molybdenum annually. At the time of his death Bob was vice president of western operations for Climax.

John Weaver owns and operates a company in Spokane, Wash., which makes plastic film heat exchangers for use in open heart surgery. He is a member of the Washington Democratic Council and active in "anti-war politics." . . . **Leonard Wechsler** is president of Black Industrial Supply Corp. in Chicago. The Wechslers have three sons: James, who has a Ph.D. in physiology and is now doing research at Marquette School of Medicine while working for his Ph.D.; Thomas, who graduated from University of Illinois, was working for a master's degree at Northwestern when he was drafted in 1969, and is now stationed in Thailand; and Michael, who is a freshman at University of Illinois. . . . **Wes Wedmeyer** is president of the St. Louis architectural firm of Wedmeyer Cernik Corrubia, Inc. The Wedmeyers have two children: Kathy, who graduated from Vassar, is now married and living in Westerly, R.I. and has three children; and Wesley Dennis, who did his undergraduate work at Princeton and graduated from Washington University Law School last June.

We have at hand information that two more of our classmates have passed away. **Ross Wood** died on August 28, 1970. He had retired from Raytheon in 1964 and was living in Wilton, N.H. at the time of his death. He is survived by his wife Katherine, a son Ross Jr., two married daughters, Nancy Hankins and Jane Maxwell and five grandchildren.

Sidney Kaye died after a brief illness on September 8, 1970. At the time of his death he was president of the Suffolk Grocery Co. of Somerville, Mass. with which he had been associated for many years. He was a past president of the M.I.T. Stein Club and in recent years had been especially active in the affairs of Brandeis University. He was national vice chairman of the fellows of Brandeis and had recently been awarded the Brandeis medal for distinguished service to higher education. His many other activities included positions as a trustee of Emerson College, Brookline Public Library, Jewish Publications Society and Beth Israel Hospital; treasurer and past president of Parker Hill Medical Center, past president of Temple Emeth Brotherhood of Brookline and director of the N. E. Wholesale Foods Distribution Association. He is survived by his wife Stella and two daughters, Mrs. Sylvia Bohrer of Nigeria and Barbara Kaye who lives in California.—**Gordon K. Lister,** 530 Fifth Ave., New York, N.Y. 10036

32

William H. Barker and his wife spent last winter's vacation in the Barbados, Antigua and the Florida Keys. They had a very interesting flight from Antigua to N.Y.C. when one engine of their 707 caught fire. They are planning to spend several weeks in London this year and to visit relatives whose family connection appears to date from 1607. . . . **Alva T. Wilson** writes only that he has gone into business for himself at the ripe old age of 59. He lives at 337 Lake Shore Dr., Duxbury, Mass. . . . **H. Francis Horton** who received his master's degree in chemical engineering with our class has been named general manager of the Engineering Dept. of Texaco Inc. located in Houston, Texas. He joined Texaco in 1936 and became chief engineer of the department in 1969.

Erskine Roberts addressed the League of Women Voters on the subject "Meeting the Growing Refuse Pollution Problem." He is with P and W Engineers Inc., Chicago, Ill. . . . **Roy C. Haeusler** was a principal speaker at the Illinois Editor's Traffic Safety Seminar in Champaign, Ill. He is chief engineer of automotive safety with Chrysler Corp. and chairman of several national safety committees.

Miss **Ina M. Curley,** of East Bridgewater, Mass., died on January 5, 1970.

John Lawrence is now Dresser Industries' Chairman of the Board and Chairman of the Executive Committee. Another M.I.T. graduate, Richard S. Morse, '33, is now Vice Chairman of the Board. . . . The **Bennett Archambaults** gave a debut dance for their youngest daughter, Michele, last June and I received a clipping from the local paper. It describes the Saddle and Cycle Club grounds as a fairyland of special lighting but with some nostalgia for the older guests. The backdrop for the receiving line was sketches from the '20s and '30s—and a bathtub filled with champagne and ice. The lead on the article: "Yes, Sir, That's my Baby!"

Dick French is retiring as director of research of Keyes Fiber Co., Waterville, Maine in June 1971. The branch plant there produces a moulded pulp. Dick and his wife plan some extended traveling, come next year. . . . **Doug Miller** is with the State Highway Department in Hartford, Conn. His avocations are do-it-yourself projects in the home and rebuilding autos. He and his wife have one married daughter, and a son who is an art student at the University of Hartford.

Jim Smith, does research on fire problems for the Factory Mutual Research Corporation. Two of his three children are married and the third, a daughter, is a student at Wellesley. . . . **Dick Craig,** who took metallurgy, has for many years been a research engineer with Alcoa Laboratories and is now located at New Kensington, Pa. His hobbies are fishing and skiing.

Joseph C. (Cobby) **Noyes, Jr.,** is now retired in Hilton Head, S.C. (which has become a retirement haven for many retired military personnel as well). Cobby was manager of research for Diamond Alkali (now Diamond Shamrock Corporation). Now that he is located in a prime recreational area, it is not too surprising that his hobbies are boating, fishing and golf. He and his wife have three children; two have already graduated from college and one is doing his stint in the army.—**Elwood W. Schafer,** Class Secretary, M.I.T. Room 13-2145; **James Harper,** Assistant Secretary, 2700 So. Grant St., Arlington, Va.

33

Saluda! We are off on a brand new year, and in a blaze of glory, headlined by three of our foreign office men; Beau Whitton, William Harper, and Cal Mohr. Beau is currently my favorite, but he better come through, as he promised to write all 10 or 15 of his Course XVII men (now extinct, I mean the Course). That was all from Beau this time but he is far ahead of most, with the possible exception of **Cal Mohr,** who also writes, this time on vacation accompanying Jean to an educational conference in Minneapolis, and he filled in the time by not forgetting his classmates. Cal notes with much pleasure that the Alumni Fund contributions from our class are up from last year, and gives me the credit. Not so, Cal. We must consider that we have a new Class Agent, and an aggressive 40th Fund Chairman. He notes that **Joel Stevens** came to visit him with his needs for filtering equipment for the Eastman Kodak plant in Kingsport, Tenn. Joel has been with Eastman most of the time since 1933. Joel also adds that he is due for a "retirement interview" very soon, so he must be wondering where the time has gone, as ain't we all? His son is working in the Chicago Area as an engineer for a steel company. Through Joel, we learn that **Andy Regan,** also with Eastman for all his years out of school, is a senior purchasing agent at the Kingsport plant. You will recall that Andy was a recent visitor to Fort Rock farm, complete with a lunch invite. Andy's son is an instructor at Michigan University Law School: again no details. How these characters can abbreviate.

Cal was recently in Kalamazoo, Michigan, (is there another), and when there he contacted the **Fred Appledorns.** They have been back in Kalamazoo since 1946, and Fred is working for Claridge Fan Co., a firm recently merged with another larger firm. And for Cal, himself, when this tome appears in January, he will be president of the Chicago Chapter of the Filtration Society, a moderately new society expanding rapidly, with sections in Boston, New York, Houston, Salt Lake City, and Toronto. Cal closes, as always with personal greetings from him and Jean to us New Hampshireites. Thanks a million, Cal.

Now for my third foreign office man, **Bill Harper.** This time Bill is real serious, and on him it looks good. He has just been made an Honorary Fellow at the

Palmer College of Chiropractic, and with that honor he received a commemorative silver medallion. Bill is recognized as a national authority on chiropractic as a profession, so ya'll may easily see that an M.I.T. man can do anything, and well. Further, Bill seems to have returned to engineering to some extent. He has been elected to the board of directors of two manufacturing concerns: one is a new company which manufactures non-electric vending machines, and the other is in research and manufacturing of synthetic coatings. So, says William, "Life becomes more interesting every day, and that S.M. from the greatest university in the world must surely be given credit for establishing the above business connections." William is mildly annoyed that he has not been given much chance to work on the 40th Reunion Fund raising, and I have told him that as Vice President he will surely get that chance when the powers that be so decree. Bill, from the heart, thanks again for your welcome letter and best to Bobbie.

As I write, October 27, I have just returned home from the first Alumni Advisory Board meeting, held at the Faculty Club last night. The Class of 1933 is always well represented at these meetings, and was this time. **Bill Barbour, Wilber Huston,** and **Westy Westaway,** brand new Chairman of the 40th Reunion committee and faithful attendee at these Alumni meetings, were among those present. Bill Barbour reminded me that Bill Huston, one of our more prominent "brains," was one of the Thomas A. Edison full-tuition scholarship boys. Bill says that he will be sending me a full biography of the rather large Huston family with six children, four boys and two girls. Now we await Bill's full story, later(?).

One cannot, and never could, get too much out of Westy, but I have permission to make quotes out of things he neglected to say. One of these items is: will not every classmate who is definitely to attend the 40th reunion, write a note to Westy and say so. The guy is hard at it, and a good preliminary list is very encouraging. Any news you put in the note to Westy will be passed on to me.

Now comes a sheaf of Alumni Fund Capsules, so, we start with an old tried and true friend, **Ellery D. Clark,** now of Torrance, Calif. Ellery is one of our true engineers; his position with Harvey Engineering Laboratory is chief stress engineer. You will recall that Ellery carried on calculations for most of the Apollos, stresswise; golly, he must be one of the unrecognized "brains." Daughter Marjorie was married 2½ years ago; Virginia was also married last spring; and son Steve is attending El Camino Junior College. Thanks a lot, Ellery, and one day, please elaborate, more especially when that first grandchild shows up.

Malcolm (Mal) Masters writes about **Leonard R. Bradford**'s passing away last month. Len was in Course II, ME. There are no further details, but Mal we appreciate your taking the time to inform us of Len's passing. And to Mrs. Bradford, the Class of 1933 is with you in your hour of grief.

From **David B. Smith,** Professor Extraordinary, we hear that he is now a lecturer at the Moore School of Electrical Engineering, University of Pennsylvania. Further, he is chairman of the board of Lanning Dynamics Inc., a consulting firm and a member of the board of several other companies. I approve, Dave. Thanks for sending in the business story.

By golly, another country heard from; this time Puerto Rico via **Bill Pleasants,** another engineer extraordinary. He has just completed his second assignment in Puerto Rico, this time a pharmaceutical plant for Squibb International Engineering Co. near Humacao. Bill says that he enjoyed seeing other M.I.T. men, like Governor Ferré, and his brother-in-law, Alberto Roig. They are, indeed, illustrious M.I.T. graduates. Accompanied by Mrs. Pleasants, Bill is now making for Djakarta, Indonesia, where he will build another plant for Squibb. Thanks for all the news, Bill. Though we hear from you less than we would hope, you surely are constant, and a faithful friend. . . . The last one to come in was from **Harry I. Summer,** still of Chicago. I quote, "I am as well as can be." What's that, Harry? It seems that the Summer boys are 100 per cent college men, with one attending the University of Illinois at Champaign, in the School of Communications and the other just starting at the University of Michigan at Ann Arbor. ". . . busy as all H... keeping our noses clean; Regards to all." Fine, Harry, many thanks and best to you and your lovely.

Not too late to classify is a word from the Alumni Fund that **Bill Huston,** at the Alumni Council meeting, received a Certificate of Appreciation for his Fund work in his region.

Now come a couple of my old standbys: **Athelstan Spilhaus** and **Richard** (Dick) **Morse.** Ath's message, this time, is his annual letter to the membership of the American Association for the Advancement of Science of which he is the current president. Ath, we recognize your fine effort, and thank you for your good job of publicizing M.I.T. through your many activities in the scientific field. . . . Through the press we learn that Dick, as Professor at the Sloan School, has instituted a brand new course for graduate students, titled "The Government-Industry Environment." (You have to get that word in someplace.) Thirty-five graduate students have signed up for it and are hard at it. The students will be divided into groups of 4 or 5, each group choosing a subject related to the course name objective. The subjects include many timely topics ranging from the discussion of legal and moral responsibilities of corporation directors to the study of alternatives to selective service. Each group will write up reports, submit them, and all students in the course will study and discuss them. Assisting Professor Morse will be several men representing diplomacy, the armed forces, and business. "What we do with these writeup reports will depend on how good they are," says Dick, "and, if they are really good enough they will be published and we will see that the right people read them." Dick seems to go on proving that he is one of our more remarkable classmates. Dick, from us all, good luck with this admirable idea.

That's it for this glorious month. Don't forget the change of my address. Stop in and see how we are doing in Florida. The address is below. Don't forget, if you write when you read this tome, the results will appear no later than April. Gad, how time flies.—**Warren J. Henderson,** Secretary, 1079 Hillsboro Beach, Pompano Beach, Fla. 33062

34

This first portion of these notes is written in Belhaven, N.C., as Jane and I are traveling down the Intracoastal Waterway. We are with friends from Long Island who are taking their 46-foot Alaskan to Florida. We joined them in Norfolk three days ago and will go at least as far as Charleston. This part of the run has included most of the long, straight cuts that have been dug through the swampy areas. It is really wild country; interesting, but not particularly beautiful. Our weather has been fair, but we're still not away from the long sleeves, long trousers temperatures. Since I will be away when the Review deadline comes along, **George Bull,** our Assistant Secretary, has kindly agreed to share the wealth and will finish up this month's notes.

Before we left Cape Cod we enjoyed seeing Olga and **Ray Jewett.** They were spending some time on the Cape and we had a chance to get together with them several times. Both are well and were enjoying a late vacation.

Recent notice of the death of Ed Lowenstein, '35, brought a letter from **Larry Stein,** part of which follows: "My own news is mixed. I was 'terminated' by my company in June after 18 and a half years. After going the route of job hunting for a couple of months, I decided to go on as a consultant. This decision was aided by my getting a contract for some work from my old employer (Sigma Instruments), which is still in effect. However, I am constantly searching for more to do in two different fields. Primarily in industrial and utility controls, and secondarily, assisting architects in specialties like alarm systems, intercoms, automatic lighting, hi-fi installations, etc. So pass the word.

"The family is growing up; two of my kids plan to be married next summer, another is a freshman at the University of Massachusetts, and the fourth is home with us, in the 7th grade. Robert will graduate as

an E.E. from Worcester next June, followed by the wedding. . . . I can't resist a little bragging by sending the enclosed clipping. I was surprised, flattered, and pleased."

The clipping referred to the 1970 Good Public Servant Award that Larry received from the South Shore Sons of Italy last October 10. The award was made for his work as: school committee chairman, school advisory committee chairman, electric service committee and electric service advisory committee, board member, treasurer and president of the Hingham Civic Orchestra, first president of the Hingham Friends of Conservation, and board member of the Hingham Civic Chorus and the Hingham Theatre for Children. And people say engineering and scientific curricula need more humanities courses because engineers and scientists don't feel their public responsibilities enough!

At this point George begins to speak and tell of his travels. Mary Elizabeth and I took a three week trip to Europe with our daughter and son-in-law. While the children went off to Italy we went to Munich and Vienna to visit friends we had made in years that we were stationed in Frankfurt/M. We had the use of a car for the time we were there and we recommend these packages that the airlines advertise very highly.

We are happy to report that members of our Class are doing an outstanding job for the Alumni Fund and that **Wilfred Mac Donnell** is receiving an award for his work as the Detroit Area Chairman and **George Westefeld** will also receive one for his work as Waterbury Regional Chairman.

Paul Archibald, Chief Metallurgist at Standard Steel Division, Baldwin-Lima Hamilton Corporation, has been elected a Fellow of the American Society for Mechanical Engineers. This is their highest grade and achievable only through nomination by members of the A.S.M.E., and approval of its council. . . . **Bill Ball** writes urging us all to support N.A.M. and such other organizations that really support American industry. On the academic scene, Bill feels that complete expulsion is the only proper reaction to students who break the rules that they have been told about when they enroll in September.

Meyer Baskin, who was a graduate student in our time but feels close to us, writes that his younger son is now a sophomore at Harvard and is doing very well. . . . **Bob Ebenbach** after leaving Budd Co. because of their losing interest in making things for the railroad industry joined a firm of transportation engineering consultants where his knowledge will be put to good use. . . . **Ed Geittmann** and his wife have been on a trade mission for the Governor of Wisconsin to stimulate business for that state. Their main objectives were Australia and New Zealand. Pretrip briefing revealed that horsemeat to Fiji was a big export, the natives having been dissuaded from eating each other. Ed's interest was alloys and bearings for tankers and bulk carriers that are being built in that area. This hardship (!) journey included stops at Tahiti and Honolulu. . . . **Ray Holland** writes that he has been a consultant for the air force almost continuously since 1958, though there have been other consulting jobs. His hobby is still kites and it has grown into a successful business called Airplane Kite Company of Roswell, N.M. Mrs. Holland is a daughter of Doc Johnson of M.I.T. They have three daughters of whom two are married and one is still in college.

One of our members on the Institute staff has taken on additional professional duties and we note that he is on the Board of Admissions of the American Meteorological Society. It is **Delbar Keily** who majored in electrical engineering, but is now in the Institute's Department of Meteorology.

George Priggen is still a pillar of Mobiloil Corporation; he is coordinator of corporate design and graphics. Does this mean that he picks the models that are to be used in company advertising?

Bill Schumacher's son Paul is back from seven years in the nuclear navy. Son Paul is in the second year of an M.B.A. at Sloan. Son Walter is at Princeton on a fellowship working for his Ph.D. Their daughter Mary is finishing high school and so Bill and his wife are in the middle of that "choosing a college" problem.

Ralph Ranger and his wife Myra are living in Exeter, N.H., where he is product sales manager for Sylvania Electric Products Corp. His son is married and has two daughters. His daughter is married and has two daughters but also a son. . . . **Ted Rimbach** announces the arrival of a granddaughter, Barbara, and a grandson, Andrew, both this year. His company is flourishing and he has moved it to larger quarters and has added to his staff.—**R. M. Franklin,** Secretary, Satucket Rd., Brewster, Mass. 02631; **G. G. Bull,** Assistant Secretary, 4961 Allan Rd., Washington, D.C. 20016

35

At a general meeting of Class Secretaries held October 15, prior to the Alumni Officers' Conference, the *Technology Review* awarded certificates of appreciation to a number of Class Secretaries in recognition of their contribution to M.I.T.'s alumni relations and to their Class, and for being represented in every issue of Volume 72 of the *Technology Review*. One of those so honored was **Phoenix Dangel,** our secretary for the 5 years ending last June at our 35th reunion.

Booz, Allen and Hamilton, Inc. has announced the election of **Charles P. Bowen, Jr.,** to Chairman of the Board. Charlie joined the company as a consultant in 1944 and has been its president since 1962 when the company became incorporated. He is also a trustee for the Committee for Economic Development, a member of the National Industrial Conference Board and a member of the Business Advisory Committee to the Graduate School of Industrial Administration at Carnegie-Mellon University.

M.I.T. sent along a note they received from **Arthur Haskins**: "Sometimes I feel busier than a kleptomaniac octopus in a jewelry store, but then one of these things comes along to fill out, and I find I have nothing new to say. Just put the boat (a 27 footer) up for the winter. Now have a cellar full of boat gear to sort, de-salt and repair. That will take through October; then I start on all those little jobs that my long-suffering wife has been trying to get me to do since I started work on the boat in the spring!" With that as a start I telephoned Art to see what was keeping him so busy at the Bath Iron Works. He told me everyone was smiling again; they just received a 3-ship follow-on contract from American Export Lines that would keep things busy for a while. He is currently manager of new construction estimating with a department of 10. Art reports that son Dan is now head of the Mechanical Engineering Department at Franklin Institute in Boston. Daughter Carolyn is a 3rd grade teacher in suburban Denver.

Edward Woll has been named vice president and general manager of the Group Engineering Division in General Electric's Aircraft Engine Group. In his new position, he is responsible for managing the activities of an organization of over 6,000 people doing research, design and development in jet engines and associated materials and processes. He will continue to maintain his residence and principal office at the Aircraft Engine Group Headquarters in Lynn, Mass., according to the announcement.

Ed served in the U.S. Air Force from 1942 to 1946 and held the rank of major. In 1946, he earned a master's degree in mechanical and aeronautical engineering from Rensselaer Polytechnic Institute and joined General Electric in Lynn as a technical engineer in Aircraft Gas Turbine Department Engineering. Following subsequent assignments as group leader and project engineer, he was named assistant to the manager of engineering in 1948. He was also manager of product planning for the Aircraft Gas Turbine Division, manager of engineering for the Lynn operation and manager of engineering for the Small Aircraft Engine Department. In 1958, he was appointed manager of the T64 Project, a post he held until 1961 when he was appointed general manager of the Small Aircraft Engine Department. In 1966 he became general manager of military production engines for the Flight Propulsion Division programs, and last January 1 was named general manager of the newly formed Military Engine Division.

Ed has received recognition from the U.S.

Department of Defense for his contribution in promoting development of the Zero Defects quality program in the U.S. defense industry. He holds several patents and is a member of the American Helicopter Society, National Aeronautics Association, Air Force Association, Association of the U.S. Army, Army Aviation Association of America, and a member of the American Institute of Aeronautics and Astronautics VTOL Aircraft Systems Committee.

Ed and his wife Barbara, have a son Edward, Jr., who is attending Georgetown University Law School, and a daughter Barbara who is an architect with a Boston firm. Ed's hobbies are skiing, boating and fishing. He commutes to Lynn from Wenham where he has lived since he joined G. E.

We have just received word of the death of **Joseph H. Lancor, Jr.,** on October 18. Course VI classmates will remember him well. When he died, he was vice president and director of Bell & Howell Research Laboratories. Joe joined the Consolidated Electrodynamics Corporation in December 1951 as Director of the company's newly formed Transducer Division. CEC later became part of the Bell & Howell Company. As director of the division, he developed two basic patents that were partially responsible for the sudden success of the young company. One was a vibration measuring system that is still in use on jet aircraft. The other is a pressure measuring device. In 1953, he was named vice president and director of CEC. Under his supervision, four new company divisions were created which have developed into major product lines, including electronic instrumentation, transducers, data recording equipment and mass spectrometers.

In June 1958, Joe was named vice president of development, a position he held until assuming his most recent position in 1967. In 1964, he conceived a method of exhibiting motion pictures on commercial jet aircraft. This idea developed into a basic patented system utilizing a single print that moves throughout the aircraft through multiple projectors. The system is presently used by major airlines and I have seen it in operation a number of times on American Airlines en route to California.

I had a chance to chat briefly on the telephone with **Hal Bemis** who reports that he is busier than ever in his outside activity as Township Commissioner. He is also serving on the Executive Board of the Philadelphia Chamber of Commerce, having retired a year ago as its president. Hal is one of the 92 alumni who received Certificates of Appreciation for their work in the 1970 Alumni Fund. . . . **Thomas F. Morrow** is one of the 8 retiring Alumni Fund Board Members who received a Certificate of Appreciation for their efforts on behalf of the 1970 Alumni Fund.

Our Class President **Robert Forster** is organizing the committee charged with reviewing the Class By-Laws and coming up with proposals to increase participation in the election of class officers. Bob has asked the following to serve: Jack Colby, Chairman, Ned Collins, Wes Loomis, Walter Stockmayer, Bernie Nelson, Ham Dow and Ed Taubman.

We got word just in time last month to let you know that **Dick Bailey** won the Class Golf Championship in the 10th year of the tournament in a very close match with **Al Johnson.** The consolation was determined a week later and **Dexter Clough** won over **Sid Grazi.** The President's Cup has been removed from my mantel piece where it sat during most of 1970, has been engraved and shipped to Dick Bailey. Dick's is the eighth name engraved on the cup donated by Leo Beckwith in 1961. Ham Dow and Sid Grazi are the only repeaters in the list which also includes Hal Bemis, Bill Barker, Art Marquardt, Bob Anderson and Allan Mowatt. If you enjoy playing golf, you should sign up for this fun tournament starting this year. All matches are at full handicap and an increasing number of us are finding opportunities to travel and play at other classmates' courses around the country.

It's time again to register for the M.I.T. Fiesta in Mexico. The 23rd Annual Event sponsored by the M.I.T. Club of Mexico City will be held there March 11-13. (See page 99 of the December issue for further details.)

At our 35th reunion class meeting I read a report from **Bill Abramowitz** who, in addition to being our Class Estate Secretary, is Chairman of our 40th Reunion Gift Committee. I think it appropriate to pass the high-lights along to you. We have raised $520,000 plus pledges of $200,000 more—a tremendous showing to date. Bill extends his appreciation for the great response and feels that a practical and realistic goal for our 40th is $1,250,000. We have increasingly felt that the 40th reunion is the most important of all, when we are below most mandatory retirement ages and while most of us are still active in business. Our 40th reunion will undoubtedly be back in Cambridge and is the one when we want everyone to come back. I am hoping the members of the varsity crew of 1935 will get an opportunity to try rowing together again —like 20 strokes!

Either you and your wife are not reading these notes very carefully, my friends, or else you just don't believe me when I tell you I like to receive letters. I haven't been exactly overwhelmed with the response so far, but maybe you plan to start a writing campaign in 1971. For my sake, and yours, I truly hope so.—**Allan Q. Mowatt,** Secretary, 61 Beaumont Ave., Newtonville, Mass. 02160

36

With our 35th reunion only a few months away I hope that you will look for any interesting memorabilia which you have stored away. Your secretary, in sorting her papers as part of several moves, has uncovered pictures et al which she will have with her at Jug End Barn, South Egremont, Mass., in June. How about the rest of you? . . . You have all received the Directory of the class which was compiled last September. Changes since then include: for Alden Anderson a new street address in Marblehead—81 Overlook Rd.; and ditto for Eugene Eberhard in Bath, Maine—353 High St. New addresses: Ernest G. Murray, 1613 Rock River, Placentia, Calif. 92670; John Sharp, 1168 Wimbledon Dr., McLean, Va. 22101; George Temple, 7 Blanchard Rd., Cumberland Center, Maine 04021; Ariel Thomas, 6 Holly Lane, Darien, Conn. 06820; and for Norman White at 30 Hagen Rd., Newton Centre, Mass. 02159.

We have just received word of the death in October, 1969, of **Jack A. Wintman** of Marblehead, Mass. I have no further information at this time. In the 1967 Alumni Directory he was recorded as being with Warner Electric Brake and Clutch Company in Beloit, Wisconsin.

Another change since the directory comes directly from **Jim Vanderpool** (51 McNamara St., in Lewiston, Maine) who writes: "I am 72 years young and semi retired. Was a late arrival at Tech but have many pleasant memories." . . . **Philip Slater** is chief actuary of Woodward, Ryan, Sharp and Davis, Inc., one of the oldest actuarial consulting firms in New York. He is also Adjunct Professor of Mathematics at Pace College. . . . In closing I must put in another plug for our upcoming reunion. Henry McGrath has committees lined up and working hard. Look for more details next month. Meanwhile, mark your calendar and save June 4 through 7.—**Alice H. Kimball,** Secretary, 100 Memorial Drive, Apt. 8-6C, Cambridge, Mass. 02142 or P.O. Box 31, West Hartland, Conn. 06091

37

Henry Blackstone is president and chairman of the Servo Corporation of America, Hicksville, L.I. . . . **Jim Ewell** is still with Proctor and Gamble as vice president of manufacturing and employee relations. He is also a director. Jim has four children of which three are married and one is a sophomore at Hirem College (Ohio). . . . **Charlie P. Witsil, Jr.,** has been with the du Pont Company for 15 years, mostly at Nashville, Tenn. . . . **Al Woll** is president of the Evansville-Vanderburgh School Corp. His son, David, is at Columbia University graduate school; his daughter, Susan, is at Southern University as a freshman and his other daughter, Helaine, is married and living in Scarsdale, N.Y.

Francis D. Houghton has recently taken a position as pesticides surveillance scientist for the State of New Hampshire. His new address is RFD #1 Warner, N.H. 03278. . . . **Sidney Levine** is editor

of *Rock Products Magazine,* Chicago, Ill., which covers construction raw materials production. . . . **Jim D. McLean** has opened a new office for business development—McLean and Company, Marina Del Rey, Calif. 90291. . . . **Ed V. Corea** is a member of the Charles River Wheelmen, a bicycle club, and he recently completed a century run from Littleton, Mass., to Peterboro, N.H. and return.

Hobby L. Hobson left Monsanto in 1967 after 21 years and spent a year in private consulting. Then he joined one of his major accounts, Aladdin Industries, Nashville, Tenn., to develop their project. Their products are now being used regularly by airlines and some of the largest hotel and motel chains. His wife Jane, continues her research work and practice in New York City. His oldest daughter, Jenny is now in New Hampshire taking graduate studies, his oldest son, Teddy, is a junior at Middlebury and another son at Portsmouth Abbey in Rhode Island, plus eight others in local schools. Hobby writes "It keeps my nose to the grindstone just providing shoes."—**Robert H. Thorson,** Secretary, 506 Riverside Ave., Medford, Mass. 02155

38

A Happy New Year to all of you in the class of 1938. With the advent of the new year, I am starting a new technique to get you to send me class news. Each month the Alumni Association sends me address changes for our mobile classmates. Since an address change generally indicates a promotion or a change of employment, instead of filing these away, I am going to send out a duplicate postcard with the urgent request that you promptly respond by giving us any news which may be of interest to our classmates.

Another helpful source of news are the envelopes to the Alumni Fund on which you are asked to write a few lines. I do get these promptly; I read them, and report them to you. A few samples follow: **Fred Ray** writes: "Still with Engineering Department of Mobil Research and Development Corp. However, the department is building new quarters outside of Princeton, N.J. Expect to move February 1, and am building new house in Hopewell Township, N.J., only a couple of miles from the new offices. Sure am going to miss that commuting! Am relying on classmate, **Fred Forman,** to sell my existing house." . . . A similar note from **Dave Baker** reads as follows: "Retiring after three-year term on Board of Directors of National Association of Manufacturers (N.A.M.). Reelected member Board of Trustees of National Council on Crime and Delinquency."

Bob Solomon pens: "Working now as a clinical pathologist in San Leandro, Calif., having retired as professor at U.S.C. Move made in order to leave deficit finance. One daughter working in speech therapy, another studies at the London School of Economics; twin sons are outstanding high school distance runners." . . . **Johnny Summerfield**'s note was brief and to the point: "Now a New Yorker. Since February, 1970, am staff vice president, economic planning, Pan American World Airways."

Don Severance writes: "Would you object violently if I asked the editor to let me put a paragraph in one of the next columns of the Class of 1938? We have come a long, long way from times when we were almost surprised to find any '38 Class Notes to this past year when our secretary was named one of those that had notes in every issue. And I would like to say that to our classmates, if you don't mind." Permission granted.

Two of our classmates received Certificates of Appreciation for their outstanding efforts in connection with the M.I.T. Alumni Fund. **Barney Mehren** served as Chairman of the San Diego area and **Ed Hadley** was Regional Chairman for the Chatham area. . . . **Harry Weese** was written up in *FORUM* as the architect for the new Time-Life Building in Chicago. According to the article there were many unique features in the design, not only from the standpoint of appearance but in the entire planning for the building.—**A. L. Bruneau, Jr.,** Hurdman and Cranstoun, Penney & Co., 140 Broadway, New York, N.Y. 10005

39

First on this month's list are several welcome responses via those familiar Alumni Fund return envelopes. Postmarked from Largo, Fla., **Leo Kiley** wrote: "Retired from the air force a year ago. Am now general manager-neutron device department of General Electric. Living on the water in Florida and enjoying it." . . . **Arthur W. Curtis** said: "Passed the half-way mark in education of my five children in June when second son graduated at Princeton, and third son completed his sophomore year there. Eldest son graduated from Johns Hopkins in 1966 and is pursuing his master's at Miami of Ohio. Daughter started college this fall; Hartford College for Women, and youngest son started high school. Retirement is a long way off still, but more desirable every day!" . . . From **Donald M. Leslie:** "I have completed a one-year stay in Japan and expect to be in Kurashiki-Mizushima area for another six months as project engineer for an ammonia plant engineered by my company, C. F. Braun. Kurashiki is a quaint and beautiful town off the tourist track, representative of old Japan. Mabel and I are trying to soak up all of the culture and lore possible during our stay here." . . . And from **Robert W. Pratt**: I continue to serve as assistant chief engineer on production engines at Pratt and Whitney Aircraft. As such I am responsible for several types of commercial and military aircraft engines and non-flight applications of our engines. Principle recreation at this point is pleasure flying. Now have two fine young grandsons."

Richard L. Steiner wrote: "I have my own office as an urban consultant in Baltimore, and in September was appointed visiting professor of community planning at the School of Social Work and Community Planning, University of Maryland in Baltimore. My main civic involvement at the moment is as president of the Board of Trustees of the Baltimore Museum of Art." . . . **John C. H. Lee, Jr.,** said that he has retired from active duty in the Corps of Engineers and is now adjunct professor of engineering at the University of Cincinnati, plus being senior associate at E. S. Preston Associates in Columbus, transportation planners. He is enjoying partial retirement! **Winthrop M. Leeds** noted that he "retired September 1, after 44 years service with the Westinghouse Electric Corporation. Last position was consulting engineer for the Power Circuit Breaker Division at Trefford, Pa. Had been awarded 90 patents."

Leonard Mautner enclosed a fine letter when forwarding his Alumni Fund contribution. Here are excerpts: "Just completed first year with new venture capital partnership—Goodman and Mautner, Ltd., after many years with Hughes Aircraft Company. We are now working with a substantial pool of capital looking for well-managed growth companies that can profitably apply high technology in growing markets. After taking Sloan School Senior Executive Program in 1965, I have a keener than ever appreciation for the management skills needed by the entrepreneur in young companies. Judging by the shortage evident in the several hundred companies we've looked at so far to invest in, good management remains in short supply. . . . Alix and I drove through Norway and Finland this summer, all the way up to North Cape. Found the scenery and the people delightful."

Fred Grant's sharp eyes spotted the announcement in the *Wall Street Journal* on October 15, that **Edward P. Skralskis,** president of Omark Industries, Portland, Oregon, was elected to the additional position of chief executive. In sending me Ed's clipping, Fred noted that their older daughter, Karan was married in August to Stephen N. Davis. Both daughters are now teaching in the Wellesley elementary schools.—**Oswald Stewart,** Secretary, 3395 Green Meadow Circle, Bethlehem, Pa. 18017

40

Belatedly, I must report the death of our classmate, **Elsie Eleanore De Mailly.** Many of you may recall her as Eleanore Clark. After leaving Tech, Eleanore attended Radcliffe for two years and married Charles F. De Mailly of our Class in September 1940. In writing for the 25th reunion book, Eleanore stated, "For the past 25 years I have been Charles' wife and any of his large or small

successes have been my claim to fame. I have two daughters and one son. The daughters are happily married and the son is in school." I have no further details at the present time. . . . From **Charles F. De Mailly** comes the note "Still president of the same old Yankee company—formerly Plymouth Cordage Co., but now the Plymouth Division of Emhart Corp., and we no longer make or sell *any* cordage—having disposed of our last rope and twine operation in 1969. Busy in metal fastener and vinyl and urethane fabrics. Plants in New Bedford, Mass., Jeffrey, N.H., Durham (Butner) N.C., Ontario, Canada, and Guadalajara, Mexico; lots of fun and variety. Kids married, seven grandchildren." . . . **Andy Stokes** writes that since 1969 he has been in business for himself at Princeton and is involved in international consulting in the chemical area, emphasizing new ventures and finding and exploiting new technology. Ample time is available so that he and Connie can sail their 34-foot sloop Pinãta to New England each summer.

Colonel **George Weinbrenner** has been awarded the Ordre National du Merite of France in special ceremonies at Andrews Air Force Base in Maryland. . . . **John Casey** is now executive vice president-sales and operations of Braniff International. . . . **Bruce Duffett,** our Class Agent, was awarded a Certificate of Appreciation from the Institute for outstanding work in the 1970 alumni fund. . . . **Charles Edwards** represented the Institute at the inauguration of the president of Whittier College on November 5, 1970. . . . **Herb Hollomon** was the banquet speaker at the conference on International Exchange of Technology on October 29. Herb has also been appointed consultant to the provost and president of M.I.T. . . . **Clement F. Burnap** writes: "Mrs. Burnap and I will return to London, England, after some years in other parts of the world to be headquarters representative to our newly wholly owned subsidiary, Pacec, International, Ltd. This company has marketing and license management responsibility for large port container shipping. We have active licenses with Vickers in U.K., Reggiane in Italy and Fruchart in Spain." . . . **Jack A. Kyger** left Avco Corporation after 15 years in August 1970, and now is the director of the newly formed, state authorized Massachusetts Science and Technology Foundation. . . . **Bob McKinley** writes, "Three grandchildren; received A.S.T.M. Award of Merit; daughters graduated from Bethany, Bucknell, Bowling Green. Student-accounting, Point Park College; Director Building Research Institute, National Academy of Sciences. Sailing Venture, 24-foot sloop." . . . From **Louis V. Russoniello** there is a note that he was appointed consultant Rehabilitation Facilities Department H.E.W.

A number of 1940 branches have just doubled. **Gary Wright** writes, "Tell Ray Keyes we are small ranchers too, with a small ranch on the Niangua River in Missouri and a farm in the Texas Pan Handle. A son in San Francisco, a married daughter in Anchorage and a married daughter in Senegal, Africa. Don't stay home much any more." Start the New Year right, write Al.—**Alvin Guttag,** Secretary, Cushman, Darby & Cushman, 730 15th St., N.W., Washington, D.C. 20005

41

Roy W. Brown has been promoted to the position of manager of the technical division of Goodyear Atomic Corp., Piketon, Ohio. He had formerly been assistant manager of that division. Roy entered Goodyear service in 1941 as a member of the production squadron. After a brief production squad assignment, he joined Goodyear Tire and Rubber Company's research department. This was interrupted by his service in the military from 1942 until 1945 when he entered development research in General Tire and Rubber Company's iceguard design department. In February, 1953, Roy joined Goodyear Atomic's engineering development and was named supervisor of process engineering in July of that year and assistant superintendent in 1957. Roy returned to General Tire and Rubber Company in 1962, where he was chief engineer of iceguard engineering and five years later returned to Goodyear Atomic as assistant manager of the technical division. He is a member of the American Institute of Chemical Engineers and serves as a Deacon of the Orchard Hill United Church of Christ. He and his wife, Frances, have three children, Lynn, Stephen, and Patricia.

Albert H. Bowker, Chancellor of City University of New York, is featured in the October 17, 1970, issue of *Education* magazine as pioneering an open admissions policy at C.U.N.Y. As a result, C.U.N.Y.'s new freshman class includes 9,000 students who would have been flatly rejected under previous admission standards. One-third of the class is nonwhite, the biggest group of black and Puerto Rican freshmen in the U.S. and includes former laborers and domestics, cab drivers, carpenters and the sons and daughters of blue-collar workers, many being the first in their families to enter college. They are described as "awed—but all business; the original American revolutionaries who want a piece of the action." At least half the freshmen are described as needing some remedial teaching before they can deal with college-level work. However, Bowker insists that changed admissions standards will not change degree standards—at least so far as he can help it. To avoid easy promotion, flunking students will be allowed to try and try again as long as teachers feel that they are making progress. He says that: "Some may take ten years to earn a degree; but they will be no novelty among C.U.N.Y.'s many part-time students. Also, bright students may soon be allowed to plan their own curriculums around a subject that fascinates them, and earn a new kind of diploma, a 'university degree'. " As for the problem of teaching C.U.N.Y.'s huge classes, the present nationwide surplus of teachers makes Bowker undaunted. He pointed out that when the university set out to hire 1,000 more teachers last spring, a single ad in the *New York Times* drew 4,000 responses, many of them from young Ph.D.s avid to help C.U.N.Y. effect social change and get well paid for doing it. Bowker has come to C.U.N.Y. from Stanford graduate school where for five years he had, as dean, pushed his faculty to the top in national ratings and drawn the attention of New York City's board of higher education which hired him in 1963 primarily to create a first-rate graduate school at C.U.N.Y. The graduate school now enrolls 28,500 graduate students. The undergraduate school has also experienced incredible growth since he took office; additions of three four-year campuses and three community colleges have been made and two more will open next fall. Enrollment of 195,000 students makes it the third largest institution of higher education in the country. Bowker was born in Winchendon, Mass., and holds a Ph.D. from Columbia besides his undergraduate degree from M.I.T.

Sterling H. Ivison, Jr., fund board member; **Frank S. Wyle** and **George S. Harrington,** area leadership chairmen, were among those alumni receiving certificates of appreciation from M.I.T. this fall for their important roles in the 1970 Alumni Fund drive.

Edward G. Sherburne, Jr., is now publisher of *Science News* magazine, and director of Science Service, institution for the popularization of science, a non-profit corporation founded in 1921.

Howard J. Samuels has been re-elected to the Board of Trustees of Franklin Pierce College. . . . **William G. Kussmaul, Jr.,** has retired from the regular army as a colonel of ordnance and is now plant manager of the Arcos Corp. in Philadelphia, Pa. . . . **James S. Cullison** was 1970 president of North American Rockwell Management Association and is environmental control engineer for the Los Angeles Division of N.A.R. . . . **James W. Neighbours** reports that after serving 21 years as an officer in the U.S. Navy (naval aviator), he became president of Agawam Aircraft Products, Inc. which was sold to Grumman Aerospace Corp., in 1964. Jim now manages the company for Grumman as a manufacturer of hydraulic assemblies for aircraft and components for space vehicles. His wife is the former Ruth B. Hall of Washington, D.C. He has a daughter Marcia who is married, a son James E. who is a junior at M.I.T., and a daughter Janet who is a sophomore at Wesley College, Dover, Del.

Stanley H. Van Greenby now holds the position of director of facility planning for Peat, Mawick, Mitchell & Co., an accounting and management consulting firm. He was formerly vice president,

real estate and office planning, for Bache and Co., a stockbrokerage firm.

Wilson R. Slaunwhite is now a professor of biochemistry on the faculty of medicine at State University of New York at Buffalo. . . . **Louise Houssiere Herrington** is now teaching French at Jennings High School, Jennings, La., a substantial change from the earth science course she taught during school year 1969-70. Her 15-year-old daughter is Louisiana State High School Tennis Champion for the year 1970. Her son is in his 2nd year of pre-medical training at Tulane University, New Orleans, La. . . . **Edward A. Eve** is regrettably reported by his wife, Elizabeth, to be ill.—**Walter J. Kreske,** Secretary, 53 State St., Boston, Mass. 02109; **Everett R. Ackerson,** Assistant Secretary, 831 Cranford Ave., Westfield, N.J.; **Michael Driscoll,** Assistant Secretary, 63 Center St., Nantucket, Mass.

42

W. E. Tucker, who received his master's in Course X with our Class, has been promoted to president of Caltex Petroleum. . . . **Moe Steinberg,** Deputy Chief Scientist of Lockheed Aircraft Corporation, has been named Fellow of the American Society for Metals for his distinguished contributions in the field of metals and materials leading to advanced aircraft, space vehicles, and deep diving submarines. . . . At its annual meeting in September, the American Management Association's Planning Council re-elected **Paul Hotte** Vice President of Research and Development. . . . Congratulations to **Francis Staszesky** who has been appointed commissioner of the Boston Council of the Boy Scouts of America. The Boston Council has 530 scout units with a membership of 18,000 youngsters. . . . **Bill Dennen** is now Acting Dean of the Graduate School at the University of Kentucky . . . **Marsh McGuire** who was materials manager of United Aircraft at Hartford is now assistant general manager at Moore Drop Forging Company, a subsidiary of Easco Corporation, at Springfield. . . . **Alfred Frueh** has moved from Montreal and is head of the Department of Geology and Geography at the University of Connecticut at Storrs.

Sandford Peek is director of engineering at Hanovia Lighting which was recently purchased by Conrad Precision Industries. Hanovia manufactures UV lamps and associated equipment, and according to Sandy the company is expanding with vigor. . . . **John Reed** has formed John Reed Associates, a management consulting firm specializing in business planning located in Westerville, Ohio. . . . One more "Commercial!" . . . **Howard Evans** writes, "This year my translation from the Swedish of Professor Gunnar Hagg's book *General and Inorganic Chemistry* was published. This is a first class general text and reference book at upperclass level, but at a not very modest price ($23—Wiley Publishing)." Howard says that he's not seen notice of the book anywhere, so I couldn't resist our scoop. . . . **Charlie Speas** is completing five years of night school study in Operations Research at Johns Hopkins and will get his Master's Degree in Management Science this January. . . . **Bob Howard,** Technical Director of the Space Systems Microelectronics Laboratory at Huntsville, is busy at defining the technology for the Space Station and Space Shuttle Programs. His two daughters are in college, one in graduate school at Cornell and the other in pre-med at the University of Alabama. The three Howard boys are in high school. . . . **Elliott Friedman**'s daughter Rosalind is a teaching assistant at Syracuse University while working for a Master's in Business Administration. His son, Warren, is a senior in high school, planning to apply for admission to Tech next year. . . . **Ed Thode**'s daughter, Karen, has received her B.A. in zoology and is now a research worker at Harvard Medical School; son Stephen is at Coe College majoring in chemistry and economics while younger son Jonathan is "a budding technologist in the 9th grade." . . . **Ed Telling** became vice president and general manager of Brewer-Titchener Corporation last January. Ed's wife is doing research at Cornell, Edward, Jr., got his M.B.A. at Cornell last spring. Younger son, Frederick, is a sophomore at Hamilton.

Alumni Fund Certificates of Appreciation are being awarded for outstanding effort in work on the 1970 Fund to **Charles H. Smith** as Cleveland Area leader and to **Bill Wilcox** as Nashville, Tenn. Regional Chairman. . . . And saved for the last item, **F. Richard Meyer, 3d,** has been awarded the 1970 Bronze Beaver by the Alumni Association for twenty years of devoted time, effort and advice to numerous leadership positions in the Chicago area. Dick has been a leader of the M.I.T. Club of Chicago, served as an Educational Councillor, has been a member of Visiting Committees and has been on the Board of Directors of the Alumni Association. We add our congratulations.—**Ken Rosett,** Secretary, 191 Albemarle Rd., White Plains, N.Y. 10605

44

Let me start off the new year with a reminder of the Alumni Fund. In the 1970 campaign, two members of our Class were honored with certificates of appreciation: **Howard S. Lockwood** in the Worcester, Mass., area, and **Peter L. Quattrochi** in Providence, R.I. **Ralph Seferian** has accepted the job for the Boston area in the 1971 drive. One other brief announcement: M.I.T. sends me copies of the change of address cards which are sent in so that if you want to know the location of anyone in the Class of 1944, you can drop me a note. Usually there is not enough space in the class notes to report all the changes so I have been omitting them.

Paul Heilman attended the Alumni Officers' Conference in October and wrote me a good description of the impressive meetings. The principal theme was to obtain information for the Commission on M.I.T. Education re: admissions, undergraduate education, graduate and lifetime education (that's us), research policy, finance and governance. Paul says the discussion groups moved on a high level of intellectual curiosity spiced by comments from students. In the afternoon he attended the session on lifetime education which was concerned with technological development, humanities, and general business problems. The concept of career nodes was suggested, where a man goes through phases in his career development at which time educational updating would be useful. On Saturday he heard a report on a new school being formed between M.I.T. and Harvard Medical School to produce men whose basic training is in the physical sciences, but who also have education in the human biological sphere. Paul saw **Will Rodemann** and **Al Picardi,** who led one of the discussion panels.

Professor **T. William Lambe** gave the 7th Terzaghi Lecture before the annual meeting of the American Society of Civil Engineers in New York. Dr. Lambe is professor of civil engineering at Tech and is president of Lambe Associates Inc., consulting engineers with offices in Concord. He spoke on "The Integrated Civil Engineering Project." Will has written three books in his specialty of soil mechanics and foundation engineering. His awards include the Norman Medal, the highest of the A.S.C.E., and the N.A.S.A. Public Service Award for his role as advisor on the Gemini and Apollo programs.

Another one of our classmates who is a company president is **Alan S. Michaels.** He relocated to Palo Alto in September to start his second company—Pharmetrics, Inc., the firm researches new techniques of drug administration. The new company is an affiliate of Amicon, of which he remains board chairman. Alan's wife, Janet, is Assistant Dean of Undergraduate Study at Stanford and their two boys are in prep school at Mt. Hermon, Mass. . . . To keep up the reputation, **Robert D. Peck,** of Needham, has been elected president and chief executive officer of Cambridge Technology, Inc. The company, while remaining in the field of environmental pollution control, will now emphasize product development and marketing as well as research. Bob founded Controlled Equipment Inc. and is currently executive vice president of the American Association for Contamination Control. He has been Lecturer at Rochester Institute of Technology and is chairman of the advisory committee for the Needham adult education program as well as being active in the Boy Scouts.

A brief note from **Will Rodemann** as I promised. "This past year has been the most interesting of all the years so far—settling our family in Dayton, Ohio;

having fun in business systems and computer-related fields as vice president-marketing at Standard Register Co.; also on Educational Council of M.I.T." . . . **Warren Signell** writes that he has left Foster Wheeler after 21 years and is now with J. J. Henry in New York as chief marine engineer. . . . **Bill van Ravenswaay** writes, "My family and I have just returned home after four interesting and pleasant years in Madrid, where I served as project manager for a 900 T/D ammonia plant built by a Spanish firm associated with my company. Our two boys are seven and ten now and we are again living in Larchmont." . . . Finally, a good comment from **Chester L. Woodworth,** "M.I.T.'s reasonably tough stand and information letters favor my continuing to give. I feel we should have kept defense contracts, however." Send your news to—**John G. Barmby,** Secretary, IIT Research Institute, 1825 K St., N.W., Washington, D.C. 20006

45

A recent *New York Sunday Times* book review by Curtis Canfield caused me to reach for a copy of our old V-12 Regulations thoughtfully forwarded by Commander **Vince Butler** following last year's reunion. Would you believe that these Station Regulations—among other things—stipulated that Trainees shall not leave bounds without permission nor drink intoxicating beverages at any time or place nor, for that matter, talk in ranks! From time to time in the months to come we shall drop various gems from these momentos of the mid 40s! Your Secretary should hasten to add that these Regulations have prompted varying comments from his teenage children and their friends—all the way from no wonder he is so understanding to now we know why he is such a prude! Speaking of the kids, I tend to feel that—and I know that I speak for most reunion attendees—the wonderful response of the 45 offsprings was the most significant feature of our 25th reunion. I do not speak of the reunion activities as such but of the wonderful friendships that have developed amongst our offsprings.

As an example, at our Betsy and Jon's insistence, Sue and **Chip Patterson** together with their parents **Charlie** and Jan spent a mid-November weekend with us in Stamford. Chip and Jon, in turn, had to have Dick Boland come over from Old Greenwich which, of course, caused us to invite Jean and **Chris Boland** as well as Billie and **Al Bowen** over for dinner and the evening. As Betsy's sign so aptly stated: A 25½ Year Mini M.I.T. Reunion!

While thinking of 45ers in Connecticut you will all be pleased to hear that **Tom Hewson,** our 1965-70 Class President, has recovered from a detached retina situation that caused major family concern. Tom indicated while on the road to recovery that he became concerned one day while playing tennis—4 opponents, two tennis balls, two rackets and light out of the side of his eye! . . . **George K. Landon, Jr.,** has recently been made a vice president of Continental Can's Flexible Packaging Division. In the same breath we should add that this appointment came about during a seven week period George spent at home in New Canaan, Conn., recovering from a broken ankle. . . . **Ed Stoltz** advises that the Stoltz family took an auto tour of the midwest and Niagara Falls during the summer rush! . . . **R. E. Harris,** Course XIIIA has recently retired from the navy as a captain. Bob is now working with the Sea Grant Program at the University of Washington. . . . **Jay Forrester,** 45's gift to the computer industry or should we say the computer's gift to '45, continues to be most news worthy. As part of its November 1970 article, "Behold the Computer Revolution," the *National Geographic* had a brief, but excellent, spread on Jay while the Organization Development Council's 1970 Publications Award went to Jay's *Urban Dynamics.* . . . **Jack B. Skinner** of Dunedin, Fla., reports that his oldest son is doing graduate work at Harvard, the next is an undergraduate at the University of Florida, while the youngest is a high school sophomore.

Jim Barrabee has recently joined the Transmission and Axle Division of North American Rockwell on the Quality Control Staff in Detroit. Jim should be congratulated upon his election as regional director of the American Society of Quality Control. . . . In case you missed our inside information of last spring, a midwest newspaper advises that **Tom Stephenson** was appointed manager of Alcoa's Davenport Works last March. The trade calls that a filler piece! . . . Rear Admiral **Arthur B. Engel,** Course XIII-A, superintendent of the Coast Guard Academy in New London from 1967 to 1970 became superintendent of the U.S. Merchant Marine Academy, Kings Point, N.Y., last June 15. From 1961-65 Admiral Engel headed the Coast Guard Academy's applied science and engineering department. . . . Another "academic" **William K. Linvill,** chairman of the Engineering-Economic System Department, School of Engineering, Stanford University, appeared as the feature in *Stanford Today* (Summer 1970) as he wrote an article captioned "Technology and the Needs of Man: a remedy to the threat that headlong technological change presents to the quality of our lives." Professor Linvill "farms" an acre in Portola Valley, Calif.; his hobbies are cycling, swimming and beach exploration (girl watching?) on the San Mateo coastline.

Marshall E. Turnbaugh, Director of Engineering at General Dynamics Quincy Shipyard and a leader in the development of the nuclear navy, died unexpectedly of a heart attack Monday, August 3. As a navy officer, Marshall served as senior technical officer for the navy and AEC in the pioneering stages of the feasibility studies, conceptual and final design and production of the first nuclear powered vessel, U.S.S. *Nautilus.* Later as nuclear power superintendent he planned and implemented procedures and facilities for nuclear power work at the Portsmouth, N.H. Naval Shipyard. After retiring as a captain in 1959, Turnbaugh served with Westinghouse Corp., J. J. McMullen Associates, New York naval architects and engineers, as well as serving as president of South Portland Engineering, Portland, Maine before joining Quincy a couple of years ago. Our deepest sympathy goes to his wife Muriel of York, Maine as well as three sons, Bryan, Michael and Jonathan.

Richard H. Battin, Associate Director, M.I.T. Instrumentation Laboratory was honored by the American Institute of Aeronautics and Astronautics for "notable work in developing software for the navigation, guidance and control of the Apollo spacecraft" at the Awards Banquet in Houston on October 22. Congratulations new Fellow! . . . Also congratulations to **Jeptha Wade** as he dutifully serves on the M.I.T. Corporation's "Committee on the Presidency" which actively seeks a replacement to and for Howard W. Johnson.

Although the last issue of the *Review* reported on the Alumni Officers Conference of mid-October it did not state that the Class was represented by Chris Boland, Dave Flood, Rey Grammer, Bob Maglathlin and yours truly. Chris and I attended the Finance Seminar and you had better believe that the Institute and its 200,000,000 is big business! We also enjoyed luncheon with a coed who together with six other girls live in the Sigma Nu House out in Brookline. . . . Bob Maglathlin, our new Class Agent, advises that there are still a few—and I fear that means several—Reunion Booklets available for sale and distribution and a postcard to me or to Bob at 601 Grove Street, Norwell, Mass., will guarantee prompt delivery at a negotiated price. Bob insists that I delay my detailed reunion comments pending your purchase. You know the situation; it is like going to a football game without a program! . . . See you next month. —**C. H. Springer,** Secretary, MFB Mutual Insurance Company, 420 Lexington Ave., New York, N.Y. 10017

46

Ned Tebbetts, chairman, and his committee have begun to firm the plans for our 25th reunion. Please make careful note that the reunion is set for June 4-7, 1971, on the M.I.T. campus. M.I.T. will allow us to use their dormitory facilities and we will make some use of the cafeteria areas. Ned wishes to emphasize that this reunion is designed not only for members of the Class, but also for wives and children. Recent 25th class reunions have been attended by more children than alumni. Our committee expects to have an interesting program designed especially for children of all ages. The reunion committee

would welcome suggestions from class members concerning activities at the reunion that would be of particular interest to them. Please mail your suggestions to Ned Tebbetts, 9 Jerusalem Road Drive, Cohassett, Mass. 02025, or to other committee members, Jim Craig, John Gunnarson, Ted Henning, Ted Heuchling, Don Hurter, C. S. Lyon and Gene Parish.

We still have a long way to go in our goal of $400,000 by reunion day. A greater effort will be needed from all of us if we are to achieve our goal. Please be generous to M.I.T. when you write your donation checks.

We received a nice reply to our postcard from **Wayne D. Bartlett** who now lives in Menlo Park, Calif. Wayne appreciated the interest in him even though he has not felt himself a member of the Class in view of his transfer to the University of Michigan in 1944. Wayne is regional manager of operations of the Western Region of Data Service. . . . **Robert B. Boomer** entered Harvard Medical School after graduation from M.I.T. and graduated as a doctor of medicine in 1951. Bob practiced Ophthalmology in Palo Alto, Calif., until 1970 when he moved to the lovely city of LaCrosse, Wisc. I travel two days a week on business and one of my regular trips is to LaCrosse. It is a fine area and I can appreciate Bob's love for clean air, hunting, fishing, and the horseback riding he finds there. Bob, his wife, Ann, and four girls are building a house and barns on the 150 acres of land they purchased. . . . **John L. Bateman** is now completing his twelfth year at the medical research center of the Brookhaven National Laboratory. The latter is primarily a physics research facility that is funded by the A.E.C., and operated by the Associated Universities, Inc., of which Tech is a member. John, his lovely wife and five children live at Upton, New York, where they enjoy beautiful sailing and boating.

Andrew B. Burns has resumed a career as an independent engineering practice. He is busy now in both systems engineering and mechanical arts. The Burns staff consists of Andy, the supervisor he married 20 years ago, and the three demanding deputies she now has added to her staff. The Burns home is way out west in Springdale, Conn. . . . **Burton Rockwell** has just completed a year as guest professor at the M.I.T. Department of Architecture. He has now returned to San Francisco in architectural practice under his firm's name of Burton Rockwell F.A.H.A. . . . **Stuart Edgerly** received his M.B.A. from Harvard after graduation from M.I.T. in 1946. He has recently been elected president of O. S. Walker Co., Inc., a maker of a broad line of specialized magnetic products, magnets, magnetizers, demagnetizers, power supplies and other items. Previously Stu held manufacturing and sales management positions with other companies, having been marketing vice president for Fenwal, Inc. prior to this new position.

Robert H. Marks has been appointed associate director of publishing and information activities of the American Institute of Physics. Before this, Bob was with the Michel-Cather, Inc., advertising agency. During the preceeding 12 years, Bob was with *Power Magazine,* rising to become managing editor before leaving for Michel-Cather. Bob and his wife, Dorothy, live in Brooklyn, N.Y. . . . **Thomas F. Malone,** Professor of Physics, has been appointed dean of the graduate school of the University of Connecticut.

David G. Hoag has been awarded the Colonel Thomas L. Thurlow navigation award for outstanding contribution to navigation. The award was for Dave's great work on the Apollo guidance, navigation and control systems. The award was made at the Air Force Academy in Colorado in July, 1970.

Presidential citations from the president of M.I.T. were awarded this fall to 39 alumni for their contribution in initiating and implementing a new program of seminars for young alumni. These seminars were held in five cities across the country and were attended by over 1,150 alumni and their wives. Our fine classmate, **Don A. Hurter,** was so honored for his work. . . . **A. T. Yu** of Hewitt-Robins has written an important article on the handling of bulk cargo in a recent issue of *Mechanical Engineering.* **—Russ Dostal,** Secretary, 18837 Palm Circle, Cleveland, Ohio 44126

47

I trust that the Holidays were enjoyable for all. Our plans are to ski in Western N.Y. State so we trust and hope that it is a white New Years. The clipping services bring news of some old friends and undoubtedly well deserved promotions or recognition of ability and service.

Ken Marshall has been elected president of the Health Industries Association. Ken is a vice president of Sherwood Medical Industries in St. Louis, a leading supplier to the health care field. In this new capacity he will be guiding some 350 organizations to best utilize their talents in this most important, growing area. . . . Several New Jersey papers announce the promotion of **Joe Riley** to vice president-down state of New Jersey Bell. Joe has been with Jersey Bell since he left school and the pictures, though they indicate that he may have lost a bit of hair and gained a few pounds, are certainly recognizable. He may write and say that my assumptions are fallacious and if such is the case I will so report. However, it appears questionable that he can still really cavort at short stop.

Bob Anderson is now a part of the largest insurance operation in Wooster, Ohio. The combine has roots a century old in this part of the country and the article indicates that perhaps Fred Heuchling, Bob and I should play golf in Leroy some time next summer.

Ken Block makes the press again stating that from his position as president of the Chicago Crime Commission he would like to see a similar organization established in his native Newark. As I write this there appears to be malpractice also in Jersey City, so he is certainly on the right track. . . . On a scholastic note **Bob Hagopian** was guest speaker at the alumni group in New Orleans. . . . **Allen Dickson** represented the Institute at the inauguration of the President of Centenary College of Louisiana. . . . **Clifton Corbett** received an award for his work on the Alumni Fund in Philadelphia.

From the notes on the back of alumni gift contributions **Ed Rosenberg** and **Chas Smith** both say hello; **Harold Brown** advises that he is in real estate and construction and Dr. **Jerry Cox** reports that he, for several years, has been director of Biomedical Computer Laboratory, Washington University and a professor in electrical engineering. . . . In closing this month would like to say that in chatting with some SAE brothers the subject of reestablishing a get together has been favorably discussed. If any of you read these notes drop me a line with your thoughts so we can organize a meeting. After that commercial I would like to assure you that equal time will be given to all. Just write—**Dick O'Donnell,** Secretary, 28516 Lincoln Rd., Bay Village, Ohio 44140

48

Mamaroneck, N.Y., has gained several new residents with '48 affiliations. **Dick Baker,** and his wife Joan had their third child last June 1. Their newest addition to the population of Mamaroneck is their daughter, Karen Elizabeth, who weighed 8 pounds, 12 ounces, at birth. Sally is five and Dick, Jr., is six. Dick called me after Alumni Day last June to explain why he and Joan had not joined the 68 other members of '48 who attended Tech. Nite at the Boston Pops. Dick was pleased to know that '48's attendance was still a record among all classes. Dick reports that his orchid and flower business was off at Easter, but Mother's Day was a success. He is also in the custom clothing business. Residents of the senior house in 1948 may remember Dick's many entrepreneurial ventures including the sale of corsages. . . . **Bob Wofsey,** moved to Mamaroneck in September. Bob is a partner in Arthur Young and Company and has moved to New York to head up their training and development programs. Bob was in his company's Boston office for several years. He is known to '48ers in the Boston area for his devoted and successful efforts on behalf of the Alumni Fund. Bob's new home is on Orienta Point in Mamaroneck, a lovely area on Long Island Sound.

James Theodosopoulos was awarded the degree of Juris Doctor at the Commencement exercises of Suffolk University. He is chairman of the Ipswich Zoning Board of Appeals. Congratulations, Jim!

Philip Bragar is serving as director of general services, a combination of most former General Services units with Technical Services operations. Phil has been with MITRE since 1959. . . . I have received notes from the following classmates: **Thomas B. Jabine** is chief of the statistical research division, U.S. Bureau of the Census. . . . Mrs. **Gertrude S. Burbank** has returned to Connecticut and her address is Talcott Natch Rd.; Farmington, Conn. 06032. She will be delighted to hear from all old acquaintances. . . . Professor **Edward P. Mikol,** has returned to the University of Wisconsin after two years as staff scientist with the National Science Foundation, an U.S.A.I.D. Science Education Improvement Project in India. Ed's concern was engineering education which involved helping concerned Indians think through their problems and to plan and implement programs for engineering education improvement. Glad to have you back in the states. . . . Still another note is from **James J. Rattray.** Jim is vice president of Syntex Labs Inc., president of Hoffman Taff of Springfield, and president of International Beef Breeders of Denver.

Barry M. Bloom, Vice President, Medicinal Products Research and Development, Pfizer Pharmaceuticals, Pfizer Inc., has been elected a Fellow of the American Institute of Chemists. The A.I.C. has more than 7,400 members in 28 chapters throughout the U.S. and is the only chemically-oriented American organization whose principal purpose is to develop the professional and economic status of chemist and chemical engineers. Dr. Bloom and family live in Lyme, Conn. Barry's undergraduate address was in Goodale or Bemis in the dorms. . . . **Harold Conroy** will be a visiting professor at M.I.T. in the department of biology for 10 months beginning September 1. . . . This year three of the entering freshmen are the sons of our classmates: Seth M. Powsner, son of **Edward Powsner**; Karl F. Koster, son of Professor **George F. Koster**; and Richard P. Chertow, son of **Bernard Chertow.** Always happy to see sons following in their fathers' footsteps. Best of luck, men.

Ralph F. Cameron has been promoted to assistant to the vice president of the International Nickel Company of Canada, Limited. Ralph continues as assistant vice president of the company's United States subsidiary. . . . One of our classmates, Professor **Elias J. Corey** of Harvard University has been selected as the 1971 recipient of the American Chemical Society's $1,000 Award for Creative Work in Synthetic Organic Chemistry. Author or coauthor of 185 research papers, Dr. Corey is widely recognized as an authority in his field. Congratulations from all your fellow classmates. . . . **William J. Weisz** has been named president of Motorola Inc. Bill started with Motorola in 1948 as a junior development engineer. He moved up through the ranks to become vice president and general manager of the communications divisions; his success with this division was a factor in his promotion last year to executive vice president. Bill is married and has three children. . . . **John W. Juechter,** of Consultech, Inc., presented a paper at the third annual North Eastern Regional Antipollution Conference at the University of Rhode Island in July. . . . . **Harmon A. Poole, Jr.,** remains "active among the majority of citizens supporting a generation we hope will be grateful for our support and remain true to those ideals which we have reason to hold dear to us." . . . **Robert E. Chandler** would like to know if there is any intention of producing a 25th year "Profile" of the class of '48, like the 10th year survey published in 1958? If not, may I suggest that it be seriously considered.

Frederick W. Furland has retired as a commander, U.S. Navy, in 1967. He is presently working as a section manager for Computer Sciences Corporation . . . **Stephen T. Davenport** has been transferred back to San Francisco as manager of engineering for pipelines and marine facilities for Becatel Incorporated. . . . **Edward Kratovil** enjoyed skiing the Alps and touring Italy this past spring. Ed said the trip was fantastic. . . . **George Keller,** President of the San Francisco Club, has recently been elected a director of the Standard Oil Company of California. . . . **Waller C. Moore** retired in July, 1969, as a captain, U.S.N. He is attending North Carolina State University for a master's degree in math. Best of luck, Waller. . . . **Charles A. Licht** is expanding operations in management and engineering consulting to cover secondary materials recovery—working with junk yards. I regret to report that his wife, Phyllis, died last July. Many of us remember the delightful days at our 20th reunion when Phyllis was with us.—**S. Martin Billett,** Secretary, 16 Greenwood Ave., Barrington, R. I. 02806

49

As Class Treasurer, **Paul Weamer** is appropriately avaricious. Consequently in return for my payment of $6.00 owed I now have a list of those who attended the 1970 Class Cocktail Party last June, and as a bonus, a financial report which showed that the Class provided about a $75.00 subsidy for the overall cost. The members attending paid for the cost of the potables while the class picked up the tab for the class letter announcing the party. Here are the attendees: Mr. Russell Cox, Mr. and Mrs. Joseph Schneider, Mr. and Mrs. John Barriger, and Senior Barrigers, Mr. and Mrs. Paul Weamer, Mr. and Mrs. Stanley Margolin, Mr. and Mrs. Edward Berly, Mr. and Mrs. James Critser, Mr. and Mrs. Fred Blatt, Mr. and Mrs. Harry Lambe, Mr. and Mrs. Demetre Ligor, Mr. and Mrs. Willard Heintz, Mr. and Mrs. George McQueen, Mr. and Mrs. Jabez Harford, Mr. and Mrs. Frank Hulswit, Mr. and Mrs. Fletcher Eaton, and Mr. and Mrs. Ed Somma.

We have seven notes from Alumni Fund envelopes this month. **Bob Steinhart** reports that he and Professor Seymour V. Pollack of Washington University have produced a 576-page college textbook that covers all the major programming languages available with the IBM System/360 and 370, *Programming the IBM System/360,* recently published by Holt, Rinehart and Winston. . . . **Walter Seibert** reports: "Since I returned to the U.S.A. to live in Teaneck, N.J. and work in New York City, I have found many changes and not all for the best. However, my geological and mining work did provide trips to Canada, Mexico, and a month in different parts of Australia." . . . **Paul Seeley** checks in with, "Just earned my 15-year service pin at RCA where I am now manager of the Electro-Optical and Control Engineering Dept., Burlington, Mass. I live with wife Doris, one boy, age 16, one boy, age 12, and daughter, 9, in Wellesley. In winter we ski."

Kenneth M. Prytherch has been promoted to marketing manager of dyestuffs and pigments, GAF Corp. He has been with them since graduation, "climbing corporate ladder rung by rung." . . . **Harvey Lyon** was promoted to rear admiral, United States Navy, in May, 1970, and ordered to duty as director, 688 Class and later SSN Project Office Naval Material Command, Washington, D.C. He now lives in Fairfax, Va. . . . **Blair Manning** moved from Scotland to Geneva in April, 1970. He now has responsibility for sales of Caterpillar products in most of Europe, including East Bloc countries. He reports a recent visit from Lorraine and **Gene Wroblewski** (with Honeywell). "It had been 19 years since we were last together!" . . . **Bill Kincaid** received an M.B.A. from the University of Chicago on September 4, 1970. He reports that his classmates included Art Wasserman and Fred Rayfield, both Tech graduates.

The Institute announces the appointment of **Eugene B. Skolnikoff** as head of the Department of Political Science, succeeding Robert Wood, who resigned to become president of the University of Massachusetts. Gene served on the White House staff for five years as an assistant to Dr. James Killian, Dr. George Kistiakowsky and Dr. Wiesner during their terms as Special Assistant to the President for Science and Technology. During the past year he has been a visiting research scholar in Geneva at the European Centre of the Carnegie Endowment for International Peace. After graduating from M.I.T. with S.B. and S.M. degrees in electrical engineering in 1950, Gene became a Rhodes Scholar at Oxford University where he obtained B.A. and M.A. degrees in economics, politics and philosophy.

Returning to M.I.T., he was a member of the Industrial Liaison Office staff for several years before military service as a project engineer in the army and a year as a systems analyst for the Institute for Defense Analysis. On a Rockefeller Foundation Scholarship, Gene returned to M.I.T. in 1963 as a lecturer and research associate in political science. He received the Ph.D. degree in 1965, be-

came associate professor in 1966 and became a full professor in 1968.

Carl Bergmann joined American Optical in 1959 and has recently been appointed assistant to the president, having been director of operations of the corporation's optical products division. Prior to joining American Optical, Carl worked for both Curtiss-Wright Corporation and Sperry Gyroscope. He and his family (wife and four children) now live in Sturbridge, Mass. . . . **H. Elmore Blanton** has been named to the technical engineering staff of Raytheon Company's Equipment Division engineering facility at Sudbury, Mass., having been with the company since 1958. He was previously with the M.I.T. Dynamic Analysis and Control Laboratory and Hycon Eastern, Inc.

On Thursday, November 12, the class officers resident in the Boston area held a meeting. Paul Weamer filed a financial report indicating a class treasury of $382.73 at the end of October, 1970. Unfortunately, I was unable to attend, but Ira Dyer reports that the group worked hard on developing a focus for the Class 25th Reunion Gift. We will have reviewed our ideas with the Institute in December and hope to be able to have plans formulated and ready to announce some time early in 1971. To remind all of you, our target is half a million dollars in class contributions for the years 1970 through 1974. Best wishes to all.—**Frank T. Hulswit,** Secretary, 77 Temple Rd., Concord, Mass. 01742

51

All of us would like to welcome the New Year by wishing all of you happiness, health and prosperity. We would also like to call your attention to this, our twentieth reunion year once again and explain that the reunion WILL be at the Provincetown Inn (and not on Martha's Vineyard). The reason for the erroneous prior report is not worth pursuing, just come to the reunion wherever it is held. **Mrs. Frederick Bentel** (Maria Azzarone) writes that she and her husband are partners in the firm of Bentel & Bentel, Architects, A.I.A., on Long Island. Maria represents a real minority: she quoted an article that states that of the 20,000 registered architects in the U.S., less than 1% are women (Betty Friedan, hear that!). She does find the role of architect, employer, wife, mother, housekeeper, etc. very demanding but very rewarding also. Her husband received his architectural degree from M.I.T. with the class of 1950. . . . **Don De Muzio** is head of manufacturing development engineering at Western Electric Co., in Reading, Pa. He and Grace enjoy skiing with their children Ann 12, Dave 10 and Beth 5. Don is a ski patrol leader at the Heidelberg ski area and invites classmates to join him when they are in the area. . . . Diane and **Nathaniel Fowler** are living in Needham, Mass. They now have three children: Glenn 13, Carol 11, and Patricia 10. Nathaniel is president of Fowler Printing Co. in Needham Heights. . . . Professor **Joseph L. Hammond, Jr.** is teaching at the Georgia Institute of Technology in the Electrical Engineering Department. Joseph and Edith have three lovely daughters: Elizabeth 16, Catherine 14 and Edith 10. . . . Andy and **Jim Hart** have moved to Littleton, Colo., where Jim is a vice president of Microwave Systems Co. They have three children: Ruth 11, David 9 and Rachel 6. Jim thinks the change from "dull, drab Chicago" is just great.

From Grosse Isle, Mich., **Harold Hurschmann** writes that nothing exciting is happening except that he bowled a once-in-a-lifetime 719 series: 249, 225, 245 to raise his average to 174. . . . **Fred McCauley** is assistant plant manager of Hercules Inc. at Plaquemine, La. Fred and Priscilla have three girls also but they have apparently done it the hard way: seventeen-year-old twins Ruth and Rebecca and 15 year old Mary. . . . Professor **Charles Miller,** now the Associate Dean of the School of Engineering at M.I.T. (and formally head of the Civil Engineering Department and Director of the Draper Laboratory, nee Instrumentation Lab), presided over the A.S.C.E. session on computers and highway design this past year. . . . Carol and **Karl Niermeyer** live in Salt Lake City, Utah with their five: Bruce 18, Jeff 17, Deb 14, Linda 13 and Jane 11. Karl is senior mining research engineer with Anaconda. He also teaches math and English to a group working toward high school equivalency certificates. He gardens and skis in his spare time.

It doesn't take very long to get picked up on an error. I'm not sure who the *first* member of our class is to have offspring at Tech, but **Jonathan Leffler** says his son Jere is now a sophomore at the Institute. Jon's wife, Ruth, went back to college to become a teacher and now teaches first grade in Howard County, Md. His own activities have been modified by a transfer to Rouse-Wates, a systems construction company owned in part by the Rouse Co. and part by Wates Ltd. of London. He is project manager of their "operation breakthrough" in St. Louis and director of construction. . . . **Robert Rullman** works for Tektronix, Inc., is on the M.I.T. Educational Council and is president of a hospital board. Hobbies include flying his own airplane and fishing. Another large family, he and Rosanna have five offspring ranging in age from 9 to 17. . . . **Murray Sirkis** is Professor of Engineering at Arizona State University in Tempe. Murray, Delores and their two young ones: Judy and Lauren (16 and 11 respectively) came to Tempe about a year ago. . . . Eleanor and **Antoni Tabak** are living in Bethel Park, Pa. where Toni works for International Nickel. They have three boys: Leon 14, Andrew 13 and Stefan 7. We had actually planned to have a "this is your life Toni Tabak" but he guessed it, so we'll pass it this time. . . . **Theodore Wehe** is with Douglas Aircraft Corp. in Long Beach, Calif., as a management systems analyst. Ted started with our class but transferred to Brown University.

By a change of address note, **John J. Welch** appears to have returned to Dallas and L.T.V. Aerospace Corp. after a stint as chief scientist with the U.S. Air Force. The family consists of wife, Patti, a 13-year-old son Kelley, and three daughters: Bridget 10, Shannon 8 and Erin 5. . . . In July of 1969, **Carroll White** became a vice president of Du Bois International in Cincinnati, a division of W.R. Grace & Co. He enjoys life more without the New York commuting and spends more time with Alice and children Lance 15, Pamela 14 and Douglas 10. . . . **Herbert Woodson** has been made director of the newly established Electric Power Systems Engineering Laboratory at the School of Engineering at the Institute. Among Herb's recent publications is a book on the application of superconductors in steam turbine generator field windings. . . . The news this month was brought to you by—**Walter O. Davis,** Assistant Secretary, 346 Forest Ave., Brockton, Mass. 02402; **Howard L. Levingston,** Secretary, 358 Emerson Road, Lexington, Mass. 02173; **Marshall Alper,** Assistant Secretary, 1130 Coronet, Pasadena, Calif. 91107; **Paul Smith,** Assistant Secretary, 11 Old Farm Road, North Caldwell, N.J. 07006

55

Last fall at the Alumni Officers Conference, presidential citations were awarded to **Randall S. Robinson, Robert W. Morgan,** and **Paul C. Valentine** for their contributions to the Alumni Association Seminar program. Also, a Certificate of Appreciation was awarded for **Dell Lanier**'s full year of contributions to Vol. 72 of the *Technology Review*. . . . The M.I.T. Club of Hartford was well represented at the conference: **Burt Kahn** and **Bob Dawson,** who are officers of the club, were there, and **Bill Lehmann** and his wife Gail also attended. Bill is now a practicing ear, nose and throat surgeon in Hartford, and there is a new addition, Cindy, to their family.

Ed Pulsifer recently moved to Illinois to be a regional sales manager for Hewlett-Packard's Data Products Group. . . . **John R. McMaster** has been promoted to program manager for preliminary design of advanced development projects at the Lockheed Aircraft Corp. . . . **James A. Stone** was made a vice president of Quantum Science Corp, a marketing consultant firm. He is now responsible for their east coast activities. . . . **Wen Liang Chen** has been promoted to associate of Skilling, Helle, Christiansen, and Robertson. He is in charge of the research and computer departments of the firm of consulting structural and civil engineers.

Harry Schreiber, Jr., has been admitted to partnership in the national accounting firm of Peat, Marwick, Mitchell and Co. Harry and his wife Peg live in Reston, Va., but his office is in New York City, where he has a midtown apartment to

ease the commuting. He is responsible for the firm's consulting practice with merchandising and distribution clients, and he missed last summer's reunion because he was in Dublin, addressing an international retailing meeting. . . . A note in *Science News* last fall mentions a new project of **Dave Nasatir.** He and his colleagues at the University of Berkeley have developed a standardized biographical data gathering system that permits the coordination of different sources for mutual benefit in the collection of biographical materials.

You can assist me with my computer-unaided biographical data gathering system by sending some recent news for the mutual benefit of the readers.—**Allan C. Schell,** Secretary, 19 Wedgemere Ave., Winchester, Mass. 01890

56

On October 22, nineteen members of the class attended a preliminary meeting to organize the June 4-6 reunion effort. From this, subcommittees are being formed and Bill Grinker will be mailing out more information soon. There are still openings so write Bill at Boston Computer Group, 15 School St., Boston 02108, or telephone at 617-227-8634.

Valentin Berger has moved to St. Louis from Seattle and joined the government in the Systems and Cost Directorate of the Army Aviation Systems Command. . . . **Forbes Brown** has joined the faculty of Lehigh University as Professor of Mechanical Engineering. . . . **Tom Cleaver** finished his Ph.D. work in economics at Harvard and is now an assistant professor at Villanova. . . . **Gideon Gartner** has joined the financial community as a security analyst at W. E. Hutton.

Henry Hebeler has returned to Boeing as general manager of the research division after a year in Tech's Sloan Program. . . . **Paul Hamburger** is manager of applications programming development at Tymshare, Newton, Mass., and lives in Lexington with wife Paula, children Susan (8), David (5).

In the September 14 *Chemical & Engineering News,* there was a long article on the Hampshire Chemical development of NTA as a possible replacement of phosphates in detergents. **Bob Pollard** as vice president—sales and **Ed Najjar** as vice president—R&D have played an important part in this project. . . . **Wendyl Reis** is vice president of operations at Webster Optical (Mass.) . . . . **Dave Shefrin** is chairman of the board of Computer Systems & Education Corp. in Hartford. . . . Dr. **Howard Trachtenberg** has joined the staff of the Springfield (Mass.) Hospital Medical Center leaving the staff of the Harvard Medical School and Beth Israel Hospital. . . . **Jim Wilson** is an Associate Professor of Civil Engineering at Duke.—Cosecretaries: **Bruce B. Bredehoft,** 3 Knollwood Dr., Dover, Mass. 02030; **T. Guy Spencer, Jr.,** 73 Church St., Weston, Mass. 02193

57

Your far-flung secretary has received a letter from an even farther-flung classmate, **Edward A. Friedman,** or better from his good wife, Arline. I will quote in its entirety: "Somehow the Tech Review is especially welcome here in Afghanistan. While looking through it and having time, as I am home with our new baby and second child, I have decided to write for my husband Edward and fill in his classmates as to our recent events. As you can tell by our address we are now located in Afghanistan where Edward has assumed the position of Chief of Party of the United States Engineering Team, which means he heads an Agency for International Development program at the Engineering School at Kabul University. This is our second stay in Afghanistan, we were here as members of the program before. He assumed this position while retaining status at Stevens Institute of Technology where he was recently promoted to Associate Professor in the Physics Department. We also just received a letter from Stevens informing Edward that he shared the Ottens Research Award for 1969-70. His work was in Brillouin Scattering from polymers near the glass transition, done in collaboration with Professor Rodney Andrews. As for family interest, our second son was born July 4, 1970 in Teheran and named Philip Kerim. Our first son was born in Afghanistan in 1965 and is called Millard Timur. We now have two Central Asian children. Just before we left the States this time, I had a one man (woman?)art show in New York at the Peter Cooper Gallery. I work under my maiden name, Arline Lederman. Well that's enough about the Friedmans this time. There are inexpensive flights from Moscow to Kabul if you want to organize an M.I.T. club of Afghanistan."

According to a recent article in the *Burlington* (Mass.), *News,* **Morris Neiman** has been chosen to receive R.C.A.'s Engineer of the Month Award at R.C.A. Aerospace Systems Division, Burlington. Morris was recognized for the award for his outstanding contributions to the Division's Huey Cobra Program. He provided the technical direction which allowed the Huey Cobra AH-1G helicopter to be refitted with R.C.A.'s low light level TV system. Morris is a senior project member in the Electro-Optics and Controls Engineering Department at R.C.A. He is a native of Poland, and resides with his wife and three children in Needham, Mass. . . . **Fred Epstein** sent us the following note: "Sara and I now have four children, a girl and three boys, the youngest of whom is now 8 months old. Aside from being Associate General Manager of Industrial Engineering and Equipment Co. (we design and build custom electric heating equipment), I have just taken office as president of the American Civil Liberties Union (ACLU) of Eastern Missouri. It's time-consuming, but interesting and vital work in these times. Last year I ran (unsuccessfully) for the local board of aldermen of a slate of like-minded 'young turks.' We didn't make it, but did pave the way for changes that have since come about. Professionally, I have taught an introductory course in atomic physics at University College of Washington University, serve on several Industry Advisory Councils for the Underwriters' Laboratories, and have published papers on electric heating."

George Waugh received his master's degree in management science from Rensselaer last June. . . . **Tom Dwyer** has been appointed plant manufacturing engineer at Corning Glass Works' Paden City, W. Va., plant. His previous position was senior engineer in forming research. . . . That's all until February when I'll include some notes and photos gathered personally on a recent trip to the States.—**Frederick L. Morefield,** Secretary, Tiirasaarentie 17, Lauttasaari, Helsinki 20, Finland

58

Good grief! Here it is time to wish you a happy New Year. Somehow the due date for December's issue escaped us and so we can only hope that your holiday season has been an enjoyable one.

About a year ago **Ed Goldman** formed a new company called Technology Associates to work on technology transfer between industry and sources of new business opportunities. Ed writes that "business has been extremely interesting with principal clients including M.I.T. and also the Government of the U.S.S.R." . . . Another entrepreneur in the consulting business is **Fred Fisher** whose firm, CPM Consultants Inc., specializes in critical path scheduling. His company is located in Natick, Mass., and his previous experience in store design and construction for Zayre Corporation provides a strong base of experience. . . . The architectural office of **Richard Linde** has now expanded to a full partnership having the name of Linde-Groth Architecture with Glenn Groth as a full partner. The scope of the firm's activities now includes churches, schools, commercial, industrial and residential buildings. In addition to these activities, he is also a member of the Sheboygan City Planning Commission.

Daniel Brand has been appointed an associate professor at the Harvard Graduate School of Design where, he writes: "I am in charge of the transportation course. I was also a member of Governor Sargent's Special Transportation Task Force charged with reassessing transportation priorities in the Commonwealth of Massachusetts." . . . The peripatetic **Mel Copen** dropped us a short note telling us: "I have been appointed as a White House Fellow and am working as a special assistant to the Secretary of Agriculture. I am currently on a one-year leave of absence from the University of Houston where I am Associate Dean of the School of Business Administration." . . . During this past summer **Richard Klafter** was a NASA-

ASEE fellow at Langley Research Center where he participated in a study of noise pollution from transportation modes. . . . According to **Bernard Schneiderman** he has been "spending a fun-filled, sun-filled year in Hawaii working with the staff of the Commander in Chief of the Pacific Fleet." (Where do we apply?) . . . And, to top it off, **Don Callahan,** alias Jacques Brel, writes: "The M.I.T. Club of Belgium is alive and well and living in Brussels. Would be glad to see other alumni visiting or living in Belgium and welcome them to join in our activities."—**Michael E. Brose,** Secretary, 199 Sudbury Rd., Concord, Mass. 01742; **Antonia D. Schuman,** 22400 Napa St., Canoga Park, Calif.

59

Before getting on with this month's installment of the adventures of our classmates, may I take this opportunity to wish you and yours a happy, healthy and prosperous 1971.

A recent press release announced the election of **Gerry Katz** to the position of corporate vice president of Witco Chemical Corp., in New York City. Gerry, who was previously assistant to the chairman of the board and manager of corporate acquisitions for Witco, will be in charge of corporate development, including acquisitions, corporate planning, data processing and systems. In addition, he will be responsible for running the Kenite Corporation, a miner, processer and marketer of diatomaceous earth filter aids and fillers. Gerry, who has his M.S. from the Institute and M.B.A. from the Harvard Graduate School of Business Administration, joined Witco in 1965 as a planning analyst.

Another press release announced the promotion of **George Elbaum** to principal, the highest rank on the technical staff of the Planning Research Corporation in Los Angeles. George, a specialist in systems engineering, nuclear engineering and energy conversion, is deputy manager of the Space Systems Department. He joined Planning Research in 1967 from TRW Systems where he was a member of the technical staff. . . . **C. F. Schlemmer, Jr.,** has been named manager of the development section of the Film Department of Rohm and Haas Co., Philadelphia. A native of Philadelphia, he joined the staff of Rohm and Haas in 1965 after obtaining an M.B.A. from Stanford University.

On the academic scene, **Jim Turner** has been promoted to associate professor, Department of Physics, at Bowdoin College. . . . **Joe Mogilner** will graduate from the University of San Diego Law School next June. . . . **Joe Kubis** is currently assistant professor of physics at Michigan State University. . . . **George Fisher** is doing elementary particle research as a physics professor at the University of Colorado. . . . **Bill Bassichis** is currently associate professor of physics at Texas A and M University having resigned his position on the faculty here at the Institute last June. Bill writes he and his wife Judith attended the wedding of **Sam Wilensky** along with Barbara and **Dick Krock** and Judy and **Dave Garelick.** He also writes that Harriet and **Ed Safran** visited **Howard Zabusky** who is now in England with Cabot Carbon Ltd. . . . **Murry Adams** is doing research for a Ph.D. in physics at Southern Methodist University and writes that he has little time for much else! . . . **Joe Johnson** is assistant professor in the mathematics department at Rutgers University. He and his wife Harriette and their two daughters —Jennifer (5) and Laurie (3)—are living in Kendall Park, N.J. . . . **Mort Rubin** cryptically writes that he is at the University of Pennsylvania but does not relate in what capacity. What are you doing, Mort?

I have received a newsy note from **John Linderman** who writes, "After graduation and spending about four years with the U.S. Army in Germany, I married Mary Ellen Chadwick (a Simmons grad, she says), went to law school, brought two children into the world, Betsy now three and one-half and Jacey now one and one-half, and am now working as a patent attorney in the firm of McCormick, Paulding and Huber in Hartford Conn." . . . **Bob Rosenfeld** also dropped a note on the Fund envelope flap and said, "After an exciting year with Applied Logic Corp., in Princeton, N.J., in the time sharing business, I have taken a position with Consumers Power Company in Jackson, Mich. Here I am concerned with putting computers to good use in a large utility." . . . **Ralph Alter** relates that he is now technical director for Telcomp Corporation of America, a subsidiary of Bolt Beranek and Newman, which offers computer time sharing services in the Northeast. Their latest services offering was to Harvard University. Ralph is currently living in Needham with his wife and two children. . . . My predecessor **Glenn Zeiders** dropped me a note—*he* knows what makes a class secretary's job easier—and stated, "Am thoroughly enjoying reading the Class Notes instead of writing them. Frankly, I'm also glad to note that other secretaries miss a few issues now and then." Touché! He goes on to say, "I joined the ranks of the 'laid-off' Ph.Ds last spring but recovered immediately by joining another Division of Avco in a better position. At this point though, I'm seriously considering having my head examined for sticking with the defense industry."

Cal Gebhart writes on his Fund envelope flap that he is still teaching mechanics at IIT in Chicago and working slowly on a Ph.D. in civil engineering. The students keep him busy as he is advisor to Young Republicans, Alpha Phi Omega, and Triangle Fraternity which he finds more fun than work. . . . **Reece Roth** relates that he obtained his Ph.D. from Cornell University's Department of Engineering Physics in 1963, and that he is currently doing high temperature plasma physics research at NASA Lewis Research Center in Cleveland. . . . **Don Giegler** dropped me a note to say that after spending nine years at General Dynamics/Convair as a control systems "dynamicist," he became principal engineer, Control Analysis Section of the Power Plant Engineering Department at Gulf General Atomic in San Diego. He is active in the local chapter of the I.E.E.E. Atomic Controls Group. He lives in San Diego with his wife Martha, a labrador and two siamese cats. He states that: "Since San Diego lays claim to the [title] 'Golfing Capitol of the World', I've become an avid hacker." . . . To end this month's column on a happy note, I am pleased to announce that on September 13, 1970, their first child, a daughter was born to the **Barrie Shabels.** —One more cigar coming up!

Well that's about all the news for now. Keep those cards and envelope flaps coming! See you all next month.—**Arthur J. Collias,** Secretary, 61 Highland Rd., Brookline, Mass. 02146

61

No question. There's a recession going on and it seems to be hitting our class fairly hard. In October there was a "telethon" to get money for the Alumni Fund from the class. I received the word from the Fund office about some of the people contacted. Several said they were in serious financial trouble. That corresponds to some indications I have had from you in the last couple of months. For example **Glenn Stoops** wrote that he "participated in the military/industrial layoffs currently in vogue. Laid off in May and joined the math department of the Naval Postgraduate School in Monterey, California as an assistant professor."

Industrial jobs inside of the mil.-ind.-compl. are hard to come by these days, but life in the education ivories does not yet appear to be materially affected. **Chris Lange,** who got a doctorate in medicine at Oxford and was a staff scientist at the Christie Hospital and Holt Radium Institute in Manchester, England, is now back in the U.S. and is at the University of Rochester School of Medicine working in radiation biology. While in England Chris married an English girl, Kathleen, and the Langes now have a 3-year-old girl. . . . **Victor Chung** has also found a haven in Academe: City College of New York branch, where he teaches physics. . . . **Jim MacStravic** is *still* a student. I had thought I was the last to leave the student status. Anyhow, Jim got an M.S.E.E. at the University of Pennsylvania in 1969 and now he is going on to a doctorate with emphasis on large scale computers.

Lloyd Fisher moves up the ladder to Associate Professor of Math at the University of Washington. . . . **Don Hartill** got his doctorate in physics in 1967 and is an assistant professor at Cornell. . . . **Roger Eckhardt** teaches chemistry at the College of Stubenville in Ohio. . . . **Gerald Wilson** is on the staff at M.I.T. in both EE

and ME working on large-scale electric power systems.

Ah, but there is still life in the old complex yet and a large number of class are still in it. **Francis Norton,** for example, is at EG&G in Salem, Mass. He is chairman of the Merrimack Valley section of the I.E.E.E. . . . **Maynard Richardson** writes: "Am still in the Patent Department at Dow Chemical. On weekends Sara and I are trying to interest our baby daughter in sailing, however at eight months her main interests seem to be chewing on the mainsheet and crawling over the rails." . . . **Dave Sachs** who is now married but still has no kids is the proud father of a first paper: "A somewhat lengthy discussion of some aspects of underwater sound." Dave will continue to grind out publishable results at Cambridge Acoustical Associates. . . . **Robert Mroczkowski** is director of research at Laser Diode Labs in Metuchen, N.J. (I think). His wife, Marcia, is a speech pathologist at nearby Midland School. They have a couple of girls, Grechen and Jennifer, who "keep us both busy."

If you've got financial trouble due to the economic situation perhaps the man to call is **Harry Baya.** He is a senior associate at Brownson and Associates in Manhattan, a personal financial consulting firm. Harry's wife, Bonnie and their son Mathew live in Hastings-on-Hudson. . . . On the other hand perhaps you would rather just drown your sorrows. Then **Bob Goldthwaite** is the man to see. He works for an unknown (by me) beer brewery. Between 1966 and 1968 he was an assistant brewmaster at their Baltimore plant. Now he has been promoted to bottleshop superintendent. He has the credentials for this sort of work being a member of both the Master Brewers Association of America (also known as the M.B.A.A.) and the Brewers and Beverage Packaging Association (known as the B.B.P.A.). The Goldthwaites have four children: two of each sex.

If you feel ill after drowning thy sorrows see **Tom Lawford** who is finishing up on his first year of residency in internal medicine in Norfolk, Va. He writes: "I remain tediously suspended in mid-air as a 1-A. My hobbies for the moment include: preserving a '57 T-bird in factory mint condition, a little ham radio on the side and bar hopping" (where, no doubt, he imbibes a bit of Goldthwaite's brew).

Warren Henderson, '33, wrote me that when he was at the M.I.T. Mexico City club Fiesta he met "**Ian Clark** and his lovely Beverly." I'm not sure what a lovely Beverly is—perhaps a Mexican car? Anyhow "Ian is an officer of the club, a hard worker, and a handsome son of a gun." . . . Penultimately, **Ira Jaffe,** our fearless leader, had a son not too long ago. David Bennett Jaffe. . . . And finally, in the low blow department: **Donald N. Graham** wrote: "You never used what I wrote last year!" Well, I used what you wrote this year, Don.—**Andrew Braun,** 464 Heath Street, Chestnut Hill, Mass. 02167

62

I attended a class secretary's meeting at M.I.T. last month and enjoyed being involved in the discussion, an opportunity I rarely get because of my location. . . . While in Boston I saw **Ed Linde,** who will be leaving his position as vice president of Cabot, Cabot, and Forbes to become a partner in a new development firm called Boston Urban Associates, along with the former chief financial officer of CC&F. The firm will concentrate on office building development in New England. . . .I also saw **Joseph Perkell,** who has returned from Vietnam and is working towards a Ph.D. at M.I.T. His wife is working towards a Ph.D. at Harvard and is also expecting a baby. . . . **Jeff Steinfeld** is also at M.I.T., but I forgot to ask him what he's doing—we got too involved in a discussion of the sense and nonsense exhibited by the activist M.I.T.

Harold Metcalf was appointed Assistant Professor of Physics at Stony Brook, New York. In July he and his wife, Marilyn, toured Scotland and England for three weeks. They spent five days at the International Conference on Atomic Physics at Oxford. David, 5, and Andy, 3, stayed home. Upon his return, Harold presented a paper in Washington at the International Conference of Precision Measurements. . . . **Jeremy Goldberg** is working for the Naval Ship Systems Command and living in Washington, D.C. with his wife, Marcia, and one-year-old son, Eliot. . . . **Willard Rodgers** is on the staff of the Institute for Social Research at the University of Michigan, having received his Ph.D. in psychology from the University of Pennsylvania in 1966 and taught for one year at Pahlavi University in Iran. His wife is Mary Ann, and they have one child. . . . **Ed Feinberg** left the air force as a captain this year and is completing a Ph.D. thesis on aeronautics at N.Y.U. He is working as a research scientist in the New Jersey Department of Environmental Protection.

John Costello is on a two-to-three-year assignment in London for Badger, Ltd., and lives in West Wickham, Kent; he would like to hear from classmates. His children are John Louis, Jr., 5, Katherine Marie, 4, and Sara Bernadette, 9 months. . . . **David Bragdon** and his wife, Jill, announced the birth of their daughter, Gwyneth Moss, on September 28. David is principal of The Well High School in Peterborough, N.H., with 12 students who constructed the school building themselves for less than $10,000, interestingly enough. . . . **Darold Rorabacher** has worked at Sanders Associates in New Hampshire since graduation. He married the former Sally Burnham in 1964 and is living in the woods along with two daughters, Anne and Marcia, one dog, and one cat.

Bill Levine received his Ph.D. in electrical engineering from M.I.T. in June, 1969. Since February, 1969, he has been an assistant professor of EE at the University of Maryland, College Park, Md. His wife, Shirley, a Wellesley alumna, is watching carefully as Bill wanders among the over 15,000 coeds on campus. . . . **Jon Davis** and his wife, Heather, spent three weeks in Europe this summer, visiting England, Amsterdam, East and West Berlin, Italy, Switzerland, and Paris. He is in telephone conduit construction as president of Archie Davis, Inc., and has two boys, Neil, 1, and Stephen, 3. . . . **George Sinclair** is writing his Ph.D. dissertation in mathematics at the University of Arizona. His wife, Joycelyn Ann, and he have a daughter, age one year, also named Joycelyn Ann. . . . **Barry Belkin** is at D. H. Wagner, Associates as operations analyst/mathematician. The firm is engaged in search analysis and theory. **Phil Schmidt**'s wife was expecting their second child when he wrote; their first is a 19-month-old boy. Phil is Assistant Professor of Mechanical Engineering at the University of Texas in Austin. . . . **Gerald Fleischli** is Assistant Professor in Community Health at an unnamed medical school and interested in the use of automation to improve health services delivery.

George Krebs completed his Ph.D. in physics at Rutgers University in 1970 and is Assistant Professor of Physics at Marietta College. He has a daughter, Laura Alison, age 1½. . . . **Henry McCarl** is Assistant Professor of Economics and Lecturer in Geology at the University of Alabama in Birmingham. He is president of the local chapter of the American Marketing Association and is a certified professional geologist. He is also serving on the Scientific Advisory Board of the University of Alabama Marine Sciences Institute. . . . **Steve Brams** is Associate Professor of Politics at N.Y.U. and has received a Science Foundation grant to do research on "Dynamic Models of Coalition Formation."

Gordon Mann called and talked with my wife, Linda, who passed on the following: he is manager—finance of the WABCO International Construction and Mining Equipment Division, based in Peoria, Ill., and traveling to Europe, South America, Australia, and South Africa. He and Gail have two children, Curt, 2, and Wendy, 1. . . . **Richard Anderson** will receive an Ed.D. from Harvard Graduate School of Education in February. He is working as a consultant in research methodology for Abt Associates, Inc., Cambridge, Mass. . . . My good friend **Leland Jackson** left Bell Labs last spring to become vice president of engineering for Rockland Systems Corporation in Blauvelt, N.Y. He is responsible for the development of digital filter products for signal processing—their first unit, a real-time digital speech synthesizer (a talking machine, friends) went to Bell Labs in August. . . . I hear that a passle of Sigma Nus are in the San Francisco Bay area, including **John Prussing,** Larry Pitts, '63, and **Max Snodderly,** among others. John's name appears regularly in the *Tech Review* as correctly submitting solutions to those problems—I didn't know he was smart besides being a jock! . . . **John R. Buta,**

specialist in the design and engineering of steel-mill and heavy metal-working equipment, has joined Paxson Machine Company in Cleveland, Ohio, as vice president—engineering. Paxson manufactures metal coil handling machinery and auxiliary equipment. He and Anne and their three sons live in Salem.

Certificates of Appreciation were presented to **Emanuel Terezakis** and **Vito Caravito** for their outstanding efforts in the 1970 M.I.T. Alumni Fund drive. The M.I.T. Presidential Citation was presented to **Fran Berlandi, Wallace Couch,** and **George Holz** for their contributions on initiating and implementing the new program of Seminars for Young Alumni. These Seminars were held in five cities across the country and were attended by over 1,150 alumni and wives.

Robert Gilmore was promoted from Instructor to Assistant Professor in the Department of Physics at M.I.T. last June. . . . While in New York recently, I saw **Art Samberg,** who is an analyst with the hot Wall Street firm of Weis, Peck, and Greer, and **Jan Hyde,** who is vice president of Eastdil, the real-estate consulting and financing arm of Eastman, Dillon. Both appeared to be prospering.—**Gerald L. Katell,** Secretary, 13751 S.E. 20th Street, Bellevue, Wash. 98005

63

Since this is being written just before Thanksgiving, it must be time to wish you all the best in 1971, and look ahead to say that, hopefully, the holiday season was pleasant for you and your family. There really is a lot of delay in this system. I think we should abolish time anyway.

The most recent class rolls arrived. We are 854 strong as of this writing. The listings include names, addresses, phone numbers, M.I.T. degrees, etc. If any of you are in need of this kind of information, please write or phone, me or the Alumni Office. The listings are separated into those who receive *Technology Review* and those who do not. There are now 336 class members who receive the magazine.

I have not as yet had a chance to receive any reaction to the complaints section of my December notes. It is my hope as well as that of a number of the other class secretaries that more discussion and exchange of ideas can take place in the notes. Of great interest, not only to your classmates, but others would be an evaluation of an M.I.T. education as you view it now. Basically, let's add more information on where we are and what we are doing. And please don't feel that the length should be that of the flap of a contribution envelope.

Births

To Jill and **Wally Weiner,** Riki Beth born in February, 1970. They are all living in Lexington, Mass. . . . To **Lawrence Pitts** a daughter, Jennifer Gaston, born in March, 1970. Lawrence is beginning a neurosurgery residency at the University of California Medical Center in San Francisco where he will be for five more years. . . . To **Richard Hull,** a son, Chris, born in January, 1970. Chris started swimming at 11 weeks and has been on TV twice and in at least four newspapers. Richard also reports that Hull Associates, employing six, "survives." . . . To Connie and **Stephen Zilles** a boy, Karl Stephen, born in June, 1970. Stephen has completed his M.S. and E.E. degrees in computer science at Tech and is continuing toward a Ph.D. Connie is working on a Ph.D. in biology at Boston University. . . . To **Phil Marcus** a son, David, born in February, 1970. Phil is enjoying Southern California, which he describes as sunny.

Doctorates

Edward Kanegsberg received a Ph.D. in physics from Rutgers in October, 1969, and is now with Litton industries. His wife Barbara (Bryn Mawr '67) received an M.S. at Rutgers and is working for the biochemistry department at U.C.L.A. . . . **Alan Schindler** received his Ph.D. in June of 1968, from Brandeis in physics. His wife Barbara received her M.D. in June of 1970, from Woman's Medical College of Pennsylvania. They have a daughter, Rebecca, age one.—**Martin Schrage,** 305 Massachusetts Ave., Arlington, Mass. 02174

64

Richard J. Adamec is working in the area of marketing research in New York City, and is also doing voluntary outside consulting for the Urban Coalition there through the auspices of the M.I.T. Alumni Association. . . . **Ed Arnn** and his wife JoAnn ended their five years of air force life in November of 1970, and have eagerly returned to civilian life. Ed's entire five years was spent at the Space and Missile Systems Organization in Los Angeles. . . . Captain **Joseph Boling** is now at Ft. Riley, Kansas, with the First Infantry Division, after completing an advanced class at the Ft. Harrison, Ind., Adjutant General School. His second child was born in January of 1970. . . . **Leslie Boring** was appointed in September of 1970, as director of the M.I.T. Associates Office, moving up from the staff of the Industrial Liaison Office. . . . **Edward Casper**'s wife Gale has recently received her Associate of Arts degree from the Manhattan Community College. . . . **Peter Chesbrough** and his wife Myra Sands have moved to suburbia in Falls Church, Va., with their three dogs and a lot of lawn to mow. Peter reports that he cannot wait for the snow! . . . **James Dorr** is a research faculty member of the Indiana University Research Computing Center, working as a technical writer and editor. Last fall he ran an unsuccessful campaign for the Indiana House of Representatives as a democrat. . . . **John Downie** is enjoying country living in Vermont as plant manager of G. W. Plastics Co. . . . **John Gilchrist, Steven Glassman,** and **David Sullivan** received M.I.T. Presidential Citations for their role in implementing Seminars for Young Alumni in Washington, D.C. last fall. . . . **Robert Hopkins** is teaching biology and chemistry at South Windsor High School in Connecticut. . . . **Juri Kolts** received his Ph.D. in metallurgy at Case Western Reserve last September. . . . **Ronald Randall** has recently published *The Learning Directory 1970-71,* a 2,000 page computer based index to teaching materials for Westinghouse Learning Corp. He is also consulting with a group working on a six million dollar O.E.O. education experiment to build computerized economic models of instructional programs. . . . **Ed Shibata** is now doing high energy physics research at Northeastern University after receiving his Ph.D. from M.I.T. last June. . . . **Riley Sinder** has forwarded to us another immortal composition as follows: "Wild rose spears in other weeds Thomas Catt, Freaked out on circumferences and lizard tails, And saw his home turned wreath. REQUIEM AETERNAM."

Alexander Spiridon received a Certificate of Appreciation from the M.I.T. Alumni Fund for his efforts as Regional Chairman in Trenton, N.J. . . . **Bill Young** and his wife Linda are living in Mt. Kisco, N.Y. Bill recently presented two papers on organic chemistry at the Berlin Liquid Crystal Conference as a representative of I.B.M. . . . **Albert Zobrist** is an assistant professor of computer sciences at U.S.C. He received his Ph.D. from the University of Wisconsin in 1970. . . . As for your class secretary, who practices law on the side, I suppose my most notable contribution to date is securing the inalienable right of fortune tellers to practice their profession in Shelby County (Memphis), by having the Tennessee Supreme Court declare a criminal statute prohibiting the same unconstitutional! Let me hear from you. —**Ron Gilman,** Secretary, 5209 Peg Lane, Memphis, Tenn. 38117

65

In perusing the secretary's files, one is struck by the number of M.D.s and medical students to emerge from our Class. **David Cook** is doing a medical residence at the University of Colorado and next year will join the Public Health Service in Baltimore. Dave married the former Beth Zemelman on August 16, 1970. Beth is a graduate of Oberlin and the University of Chicago and works in the publication department of Temple Buel College. . . . **Richard Grant** has left the M.I.T. graduate school and started medical school at Boston University in September of 1970. His wife Sue (M.I.T. '67) is also at B.U. Medical School and is a year ahead of Dick. . . . **Bill Brody** is at Stanford Medical School and is also doing graduate work at the Stanford Integrated Circuit Laboratory (information courtesy of **Wayne Chase**). . . . **Ed Hoffer** is doing a first-year residency in Internal Medicine at Massachusetts General Hospital. His research

plans include investigations of the application of computers to clinical medicine. Ed reports that **Mike Long** is starting an anesthesiology residency at Mass General.

A number of our classmates report new jobs, or promotions in their current ones. Among them: **Henry Lichstein** who left the Pentagon in August and is now an assistant vice president at the First National City Bank in New York. Hank is working with management control systems and enjoying the Manhattan life. . . . **Joel Rocha Rivero** is director general of Germex, a company in the PVC coating field. Joel has been at Germex since leaving M.I.T. and reports that the M.I.T. education has helped him in acquiring perspective when approaching a problem. . . . **Richard Nathan** has been promoted to project leader at the Battelle Memorial Institute's Department of Biology, Environment and Chemistry. Dick reports the birth of a daughter, Wendy, on July 5, 1970. . . . **David Crawford** is living in Racine, Wisconsin and has been promoted to supervisor of payroll and general accounting of the foundry plant of the J. I. Case Company.

The Alumni Association reports that certificates of appreciation will go to **Bill Brody** and **Jim Taylor** for their efforts on behalf of M.I.T. in the 1970 Alumni Fund. **Carol Van Aken, George Berry** and your secretary received the presidential citation from the Association for work on the Young Alumni Seminars held during the last year.

This is the first edition of 1965 Class Notes not prepared by **Jim Wolf.** The class owes him a vote of thanks for more than five years of service as secretary. I would add a personal note of thanks to Jim for continuing to prepare Class Notes while I returned to the Boston area from an Omaha, Nebraska, assignment with the MITRE Corporation. I will try to make the Class Notes as good as Jim's and hope for the help of all classmates in the form of letters, postcards, calls or visits.—**Steve Lipner,** Secretary, 940 Belmont St., Watertown, Mass. 02172

66

Lewis Gaines married Roberta Dicks in June 1968, and they are expecting their first child in February. Lewis is "surviving government spending cutbacks at Tyco Labs in Waltham doing research on high energy density battery systems." In July, **Carson Eoyang** presented two papers in Taipei, Taiwan, to the 1970 Seminar on Modern Engineering and Technology. He is presently on leave of absence from McDonnell Douglas Astronautics, pursuing a Ph.D. in organizational behavior at Stanford's Business School. He says it's nice to be at a school with a decent football team for a change. I guess so, what with a Rose Bowl squad and yesterday's selection of Plunkett as Heisman Trophy winner!

Jim Kester is now a captain in the air force, just past the four-year mark with them. He is working as a meteorologist for the 11th Weather Squadron, Elmendorf Air Force Base, Anchorage, Alaska . . . **Mark Yogman** gave a simulation course for Esso Eastern in Bangkok in September and just missed being hijacked by Palestine guerrillas to Jordan. . . . Cheers.—**Terry J. Vander Werff,** 2049 Manchester Dr., Fort Collins, Colo. 80521

67

Last June several of the members of our class received degrees from Harvard. **Steve Marcus** and **Jim Foster** graduated from Harvard Law School. **Mohammad Ilahi, George Jones,** and **Margaret Jones** received M.B.A.s from Harvard Business School. **Reinier Beeuwkes** and **Bill Carter** graduated from the Graduate School of Arts and Sciences, and **Jeff Dodson** and **Michael Narosny** received M.A.T.s from the School of Education.

Class agent **Chuck Kolb** will receive a Certificate of Appreciation for outstanding efforts on behalf of the 1970 Alumni Fund. . . . **Steve Flaum** is planning to marry Jo Ann Simon. . . . **Greg Wight** is in the air force and has passed the halfway mark in his tour; he has about 700 days to go and is still counting. . . . **Gene** and **Ruth Fax** are proud to announce the birth of a son, Joseph Alexander (July 26). . . . **Donald Davis** is still enjoying life as a graduate student in math at Stanford. He has his first child, Joelle, born August 3, 1970. . . . **Jerome Milch** has received a Woodrow Wilson Fellowship. . . . **John Fittz** writes that he is "engaged in spiritual revolution—to capture the minds of college students for a love and peace that comes only by following and believing in history's greatest leader and revolutionary, Jesus." John is directing the thrust of Campus Crusade for Christ in western Massachusetts.

Janice and **Mel Snyder** and **Roy Gamse** will attempt communication with **Spence Sherman**'s mind on January 9 at 5:00. They hope to find someone home then.

On July 6, Penny and **John Halberstadt** were greeted by their third child. John is enjoying his job with Du Pont and continuing his work toward an M.B.A. at the University of Delaware at a relaxed pace of one course per term. . . . **Jim Kirtley** is closing in on a Ph.D. at M.I.T.; he's building a rotating machine.(?) . . . **Andrew Egendorf** writes that activities with Ralph Nader have led to a real student power group on behalf of the consumer. Testimony has been given before Congress by students, and observable changes have taken place in the federal bureaucracy. Andrew is still at Harvard in the joint J.D./M.B.A. program. . . . **Michael Cohen** is living in Cambridge and working for Digital Equipment Corporation. He was working for Hewlett-Packard in California. . . . Last July **Daniel Hester** married the former Liudia Normantas, a graduate of Marywood College in Scranton, Penn. . . . **Bruce Jacobs** has begun work on his doctoral dissertation in political science at Harvard. He has completed directing a national evaluation of Community Action Programs for the Office of Economic Opportunity.

Tom Compton quit graduate school at M.I.T. last January and has started as a management trainee with First National Bank of Boston. . . . **Roy Gamse** is doing part time graduate work at Sloan while being occupationally deferred at MITRE Corporation.

Since graduation **Richard Haberman** has been a teaching assistant in an M.I.T. doctoral program in applied mathematics. He was married February 1, 1969; **Jon Sussman** was best man, and **Mike Schiff** was an usher. . . . Mr. and Mrs. **Avram Markowitz** have a son, Barak Bar-Cohen, born September 18. . . . **Pete Denton** graduated from Harvard Business School in January, 1969. He reports that he went straight through in order to beat the draft. Pete got a deferred job with Peat, Marwick, Livingston & Co., a management consulting firm, and is also continuing to do consulting work for the Department of Defense. He was recently promoted to senior consultant. Evidentally he likes being a bachelor; two years ago he went to Europe to ski, and last year he went to Vail. Another trip to Europe is being planned, and he's looking for a group of people interested in cutting expenses.

John Patterson received his B.S. and M.S. degrees in electrical engineering in June of 1968 and then worked for General Radio until September when he went on active duty. He spent about three months in Navy Aviation Officer Candidate School and emerged as a "shiny new ensign." While on flight training in Pensacola and Corpus Christi, John picked up a second M.S. courtesy of Uncle Sam and University of West Florida. He received his "wings of gold" in June and headed out to see the world in his first permanent duty station, Washington, D.C. John notes happily that he is still guarding his bachelorhood even though no one seems likely to steal it.

Roy Talus moved to American Enka Corporation after one and a half years with 3M Corporation. He was recently promoted to project leader. Roy is married and has a daughter. . . . **Joel Berk** is working at Union Carbide headquarters in New York City while his wife Nancy is enrolled in a Ph.D. program in English literature at City University of New York. They live in Greenwich Village. . . . **Larry Banks** received his electrical engineering degree in June and is now with Hewlett-Packard Medical Electronics Division, Waltham, Mass.—**Jim Swanson,** 774 Channing Ave., Palo Alto, Calif. 94301

68

It is a gray and rainy Sunday afternoon, and our normally scenic view of the Charles and Boston beyond has been washed out by the dusk and the haze. Rather than spend the rest of the day

lamenting the weather and other forces beyond my control, I shall turn my mind to the typewriter, and the pile of notes waiting to become this month's column.

I'll start the column with a light and cheerful note we got from **William Klein,** who is at U.C.L.A., reviewing his recent activities. "It was a good spring. Found a four leaf clover, got an N.S.F. fellowship, delivered a paper on membrane energetics at the American Society of Biological Chemists meeting, and represented the U.S. at a month long UNESCO meeting on bacterial membranes in Paris. *C'est si bon!*"

Barry Mitnick has brought us up to date on his recent activities, which include a change of schools and fields. He received a master's degree in physics from Columbia University last February, but left Columbia and physics in June for a Ph.D. in political science at the University of Pennsylvania. . . . **Joel Wolf** writes that he has passed his preliminary exams in mathematics at Brown and is now working towards his Ph.D. His wife Cathy is also at Brown, going for a Ph.D. in psychology. . . . **Robert Rifkin** writes that he is in his third year at N.Y.U. School of Medicine. Ditto for **Paul Gluck,** who also informs us that he is engaged to a classmate there, Joan Chernoff (University of Pennsylvania, '68). A summer wedding is planned. . . . **Phil Weidner** is now back at Harvard Law school after a one year leave of absence, part of which he spent in Aspen, Colo., skiing and tending bar. He has married Maria Viteri, Marquette University,'68. He urges classmates "to designate alumni gifts to Fassett Fund and flower power." . . . Our class president, **John Kotter,** is now working on a doctorate in organizational behavior at Harvard Business School, having completed a master's at the Sloan School. . . . Two classmates are currently studying at the Harvard School of Education—**Ginny Fano** and **Stan Gambrill.**

And of course we had a few notes from people in the "still at M.I.T." category. **John Vitek** is here in the Metallurgy Department, working as a research assistant and studying for his doctorate. He and his wife Marty had their first child in late November. . . . . **Ronald Bohm** is in the Sloan School, working for his Ph.D. in planning and control systems. . . . **Richard Tremaglio** was promoted from Instructor to Assistant Professor in the Department of Architecture for two years, as of last July.

We also heard from **Gunnar Jacobsen,** who was able to visit M.I.T. on the way home from a business trip to Japan. He reports that he enjoyed seeing some of his old friends again, and that he liked some of the recent attempts that are being made to liven up the old Institute. A word on that for those who haven't heard about it—those sacred gray walls you all remember so well are being transformed by bright patches of color in stair wells, and by large posters and paintings along the corridor. Change is slow, of course. Turn a corner and the old gray and drab is still there, but the main corridor is really undergoing something of a "sea-change." *(For another view see the Class of 1918, p. 118 of this issue.)*

A number of people also reported on their progress fighting with or against the military. **Rich Lufkin** is an assistant electronics material officer on board the U.S.S. *Independence,* with responsibility for all the ship's communications gear maintenance, a nice way to use his business-engineering background, he feels. He shares his office with Lieutenant Charles Frasier, '65. . . . **Howard Ostroff** is serving as an engineering officer in the navy aboard the U.S.S. *Sumter,* a new class of L.S.T. . . . Also in the navy is Lieutenant (jg) **Ken Theriault,** who reports that he married Marcie Abramson at the M.I.T. Chapel last June 21, and left on a five-month cruise 30 days later. The cruise—UNITAS XI—is a circumnavigation of South America, via the Straits of Magellan and the Panama Canal, operating with various South American navies. "Interesting, but too hard on a young marriage for my taste", is his comment.

Stephen Reimers reports that he was promoted to Lieutenant (jg) last June. A qualified Navy diver himself, he is continuing as the Project Officer for the U.S. Navy Experimental Diving Unit in the Washington Navy Yard. . . . In the army we have **Paul Ware,** who is presently a First Lieutenant in the Quartermaster Corps, serving with MACV Advisory Team 10 in Can Tho, Vietnam. When he returns to the U.S. in April, he will ETS from the army, and he plans on coming to Boston for a long vacation.

On the other side of the fence, we have **Jeff Stokes,** who reports that he returned his draft card to his local board and explained why he can no longer cooperate with the military. In addition, he asks us to watch for a new Congressman, Ronald Dellums, on whose campaign he worked. Jeff is living with **John Jaros, Robert Kovsky,** "two others and a cat." . . . **Dennis Noson** reports his pleasure that the army is no longer a part of his life. "Divorce is sweet," he says, "especially when you've been married to a drab, authoritarian wife (not to imply that the army is feminine, but that I'm a male and therefore subject to military duty)." He is now back at college, taking time out for some poetry and physics. And just to show that this problem isn't ours alone, **Fred Heutink,** who is working in Holland, reports that the Dutch government is pursuing him for the armed forces on the basis of his Dutch birth (even though he is now Canadian). He expects to remain a civilian since he is only there temporarily, is the head breadwinner, and is essential for research.

Tom Rozsa is our class hero this month, having written us a letter describing his activities, plus those of several classmates. After leaving M.I.T., Tom went to N.Y.U., where he received a master's degree in aero and astro in June 1969. Following that, he went to work for Lockheed, where he is in structural dynamic loads. Having decided that "a Ph.D. is hardly the degree to get these days," he chose instead to get an M.B.A., and is currently working towards that goal at U.C.L.A. on a work-study program with Lockheed. He reports that **George Holst** and **Dave Pack** are at Lockheed with him. George is in the weights group, working on the S3-A Navy anti-submarine plane, and Dave is in aerodynamics. Tom and Dave are both working on the Lockheed L-1011 commercial jet transport. Finally, Tom reports that **Joseph Young** is working at I.T.T. Gilfillan, in Los Angeles, doing mechanical engineering type work on housings for radar equipment.

Our letters this month come from as far away as Paris and Peru. From Paris, we heard from **Joseph Fiksel,** who brings us up to date on his activities "for the sake of nostalgia and long-lost friends." After graduating from M.I.T., Joe spent a year at Stanford, where he obtained a master's degree in operations research. He then returned to his native Montreal, where he was a lecturer in mathematics at Sir George Williams University. Now he has left Montreal to accept a Government of France scholarship for doctoral study at the Faculté des Sciences. Joe writes that he is there now, trying to bridge the culture gap separating Paris from the rest of the Western World. He solicits any encouragement at: Chambre 119g, Maison du Liban, Cité Universitaire, Paris 14eme, France. . . . And from Peru, **John Sole** writes that he has survived earthquakes, currency crises and expropriation, and is still with Brown and Root, Inc., constructing offshore drilling platforms and submarine pipelines for Belco Petroleum Corp. He is project manager for the operation.

I am sad to report the death of **John Fishback** on February 25, 1970. Prior to his death he was a student at Berkeley. While at M.I.T., John was in Course VIII and was a member of DU. He was also on the wrestling team and was elected to Q Club. On behalf of the class I extend our sincere condolences to John's family and friends.

Finally, we have two awards to report. **Jerry Grochow,** our Class Agent, received a Certificate of Appreciation for his work in the 1970 Alumni Fund effort. And Mike received a commendation from *Technology Review* for having contributed a column to every Review issue for the past year. Actually, Mike (and I) haven't missed an issue since graduation, and that's two and a half years now. So, for anyone who has read this far in great suspense over which of us was writing this column, I guess I just gave myself away! It's the first good size column Mike has let me write in a while, and it was a better way to spend the day than staring out into the rain.—**Gail** and **Michael Marcus,** Secretaries, Eastgate Apt. 16A, Cambridge, Mass. 02142

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